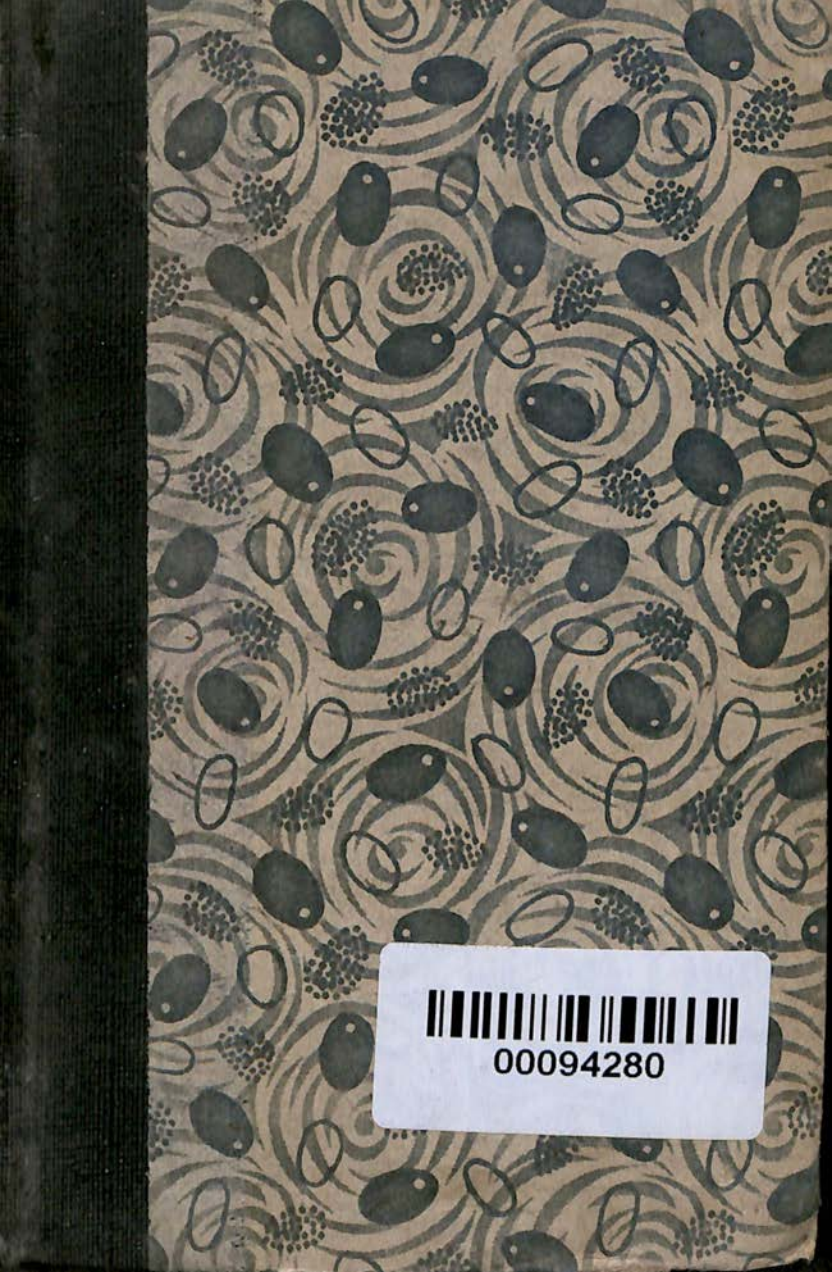
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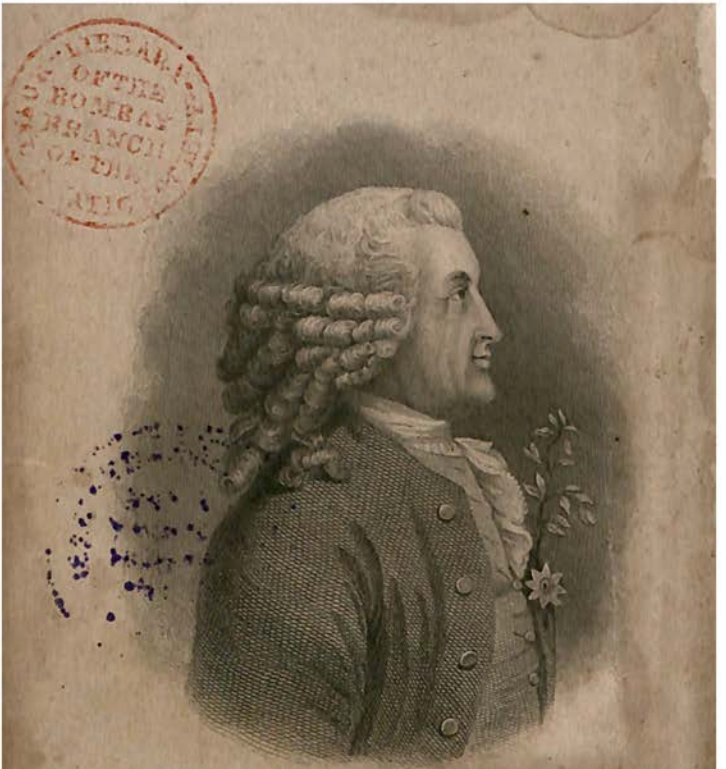

LINNAEUS.

PUBLISHED BY OLIVER & BOYD, EDINBURGH

LIVES

OF

EMINENT ZOOLOGISTS,

FROM

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ARISTOTLE TO LINNÆUS:

WITH

INTRODUCTORY REMARKS ON THE STUDY OF NATURAL HISTORY,

AND

OCCASIONAL OBSERVATIONS ON THE PROGRESS OF ZOOLOGY.

LIBRARY OF THE BOMBAY BRANCH OF THE ROYAL ASIATIC SOCIETY.

BY W. MACGILLIVRAY, A.M., F.R.S.E.

Author of "A Narrative of the Travels and Researches of Alexander Von Humboldt."

WITH A PORTRAIT OF LINNÆUS ENGRAVED BY HORSBURGH.

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PREFACE.

NATURAL HISTORY has of late become a favourite pursuit in this country; and although its progress as a study may not have been equal to the enthusiasm which it has excited, its general effect is unquestionably beneficial. In consequence of the interest which it has created, a great variety of works, from the simple catechism to the elaborate treatise, have appeared in rapid succession. But while compends and manuals are thus multiplied, little has been said with regard to the private history and professional pursuits of the distinguished persons who have contributed most to the general stock of knowledge from which these popular essays have in a great measure been derived. We have, therefore, endeavoured in some degree to supply this deficiency, by presenting a series of Lives of the more Eminent Zoologists, from Aristotle to Linnæus inclusive.

In the Introduction will be found a view of the objects, to the investigation of which the talents of the individuals whose annals we record were principally directed. The remarks there offered are calculated to enable such readers as may not have been

previously acquainted with the subject to comprehend many circumstances which might otherwise appear unintelligible.

Few, even of those who have made considerable progress in the study of nature, are aware of the difficulties with which the ancient philosophers had to contend. For this reason we have begun with Aristotle, the founder of Natural History among the Greeks. A biography of the elder Pliny, the greatest of Roman writers in this department, comes next in order. The lives of the more remarkable zoologists who flourished after the revival of learning in Europe are briefly sketched; while some degree of connexion has been given to the series by remarks on the progress of knowledge at that period, on the labours of their contemporaries, and on the principal works which occasionally issued from colleges and museums. Although it is unnecessary here to enumerate all the names that enter into the catalogue of zoological writers of the sixteenth and seventeenth centuries, Swammerdam, Ray, and Reaumur, may be particularly mentioned. The great Linnæus witnessed the termination of those dark ages, during which his favourite pursuits were treated with comparative neglect, and the commencement of a happier era, in which they were to assume the dignity of a science. His life is given with more detail than those of his predecessors, both because the facts relating to him are more abundant, and because he exercised a more decided influence upon the opinions of Europe. The volume concludes with a notice respecting his son, which forms an appropriate appendix to that of his more distinguished parent.

Although the lives of studious men may, generally speaking, present fewer striking incidents than those of warriors, navigators, and politicians, yet the memoirs of naturalists are always extremely interesting, on account of the connexion in which they are necessarily placed with whatever is curious, beautiful, or sublime in creation. Some of them, too, will be found to have occupied a high station in society; others to have forced their way through numberless obstacles, before obtaining the end of their ambition; while a third class are seen perishing in the midst of their career, the victims of indiscretion, or of neglect. Certain highly-gifted individuals, again, shine as bright luminaries in the firmament of science, and extend their influence over the whole of the civilized world; while the labours of nearly all have been in some degree productive of good. Perhaps there is no order of men to whose charge so little positive evil can be laid; and if their studies do not always elevate the mind above the corroding cares and cankering jealousies of life, they at least tend to bring it into a more immediate relation with the great Creator and Governor of the universe.

It is not therefore imagined that the general reader will find the following sketches destitute of interest, even although he should possess only a superficial knowledge of the principles and phenomena to which they refer. The professional student, on the other hand, cannot fail to obtain in them information which will prove of the utmost value to him, whether viewed as a guide, or as a stimulus to exertion; and even the accomplished naturalist may derive pleasure from the general review of the labours of

those to whom he is mainly indebted for the knowledge which he possesses.

The authorities which have been consulted with reference to these Lives are too numerous to be mentioned here; but the more important are pointed out as occasion presents. It may be sufficient to remark, that no modern work on Natural History would be deserving of public confidence, which did not acknowledge some obligation to the valuable labours of the French School, and of Sir James Edward Smith in our own country.

The second volume, already in preparation, will be devoted to the most distinguished writers in the same department, from Pallas, Brisson, and Buffon, down to Cuvier, and will conclude with General Reflections on the present state of the science.

EDINBURGH, *June* 1834.

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LIVES

OF

EMINENT ZOOLOGISTS.

Introduction.

Remarks on the Estimation in which Natural History is held at the present Day, and on its Importance—Men are more conversant with Nature in uncivilized Life—The original State of Man, and his progressive Acquisition of Knowledge—General View of the Objects of Natural History: the Earth's Surface and Structure, the Ocean, the Atmosphere, Plants, and Animals—Definition of Mineralogy, Botany, and Zoology—Sketch of the Progress of Zoology: four Eras distinguished, as marked by the Names of Aristotle, Pliny, Linnæus, and Cuvier.

At no period in the progress of civilisation have the advantages to be derived from the study of nature been so highly appreciated as at the present day, when descriptions and representations of the various objects by which we are surrounded, or which have been observed in distant countries, are issuing from the press in a variety of forms calculated to attract the attention and to gratify the taste of almost every class of society. Only a few years ago, Natural History was held in some degree of contempt by the enlightened as well as by the ignorant; its cul-

tivators were considered as triflers, wasting their energies upon that which could profit nothing; and the information which it affords was looked upon as unworthy of the attention of persons fitted for intellectual pursuits. Now, it is raised in popular estimation to the highest dignity, and is pronounced to be a science capable of exercising the most splendid talents, and of affording pleasure to the most improved minds.

Of the several changes that have recently taken place in society this is not the least important. The diversified productions of Nature,—those objects, in the formation of which have been exercised unlimited wisdom and power,—are not now considered beneath the notice of the wisest of the sons of men. It still, however, remains to be perceived, that in the construction of the familiar fly that buzzes through our apartments, not less than in the frame of the mighty elephant,—in the simple blade of grass that springs from between the stones of the pavement, not less than in the knotted oak or the graceful palm,—in the small cube of salt, not less than in the granitic mountain or the volcanic cone,—there is something of a mysterious nature, the comprehension of which would be a much more glorious achievement than any that the human intellect has yet performed. The ship that carries the adventurous merchant over the great ocean is an object worthy of our admiration; but how complicated is its apparatus, compared with the fins of the most common fish! The balloon that floats calmly in the atmosphere,—what an unwieldy instrument is it, compared with those beautiful organs of Divine workmanship by which the swallow is conveyed

from the equatorial to the polar lands, or pursues its prey through the pathless air!

Man, in the early stages of his existence, is drawn by an instinctive power to observe and admire nature. The love of it, too, glows in the breast of every child. We have never, indeed, witnessed the actions of men in the infancy of society, and therefore cannot estimate the influence exercised upon them by external objects; for the savages whom the European, wandering over the globe in quest of gold or knowledge, finds in the deserts or in the remote isles of the ocean, are evidently degraded beings who have degenerated from a nobler stock. But the history and traditions of most of the tribes with which we are acquainted, and especially of those inhabiting the American continent, show that at some remote period they must have possessed more knowledge than they exhibited at our first acquaintance with them. Revelation, too, assures us that man was made perfect; and philosophy has not succeeded in forming a theory to account for the physical or moral diversities exhibited by our race, approaching in consistency to that which may be drawn from the pages of the Sacred Writings.

"Man," says Cuvier, "who was cast feeble and naked on the surface of the globe, seemed created for inevitable destruction. Evils assailed him on all sides; the remedies remained concealed from him, but he had been endowed with genius for discovering them. The first savages gathered in the woods some nutritious fruits, some wholesome roots, and thus satisfied their more urgent wants. The first shepherds perceived that the stars follow

a regular course, and were directed by them in their journeys over the plains of the desert. Such was the origin of the mathematical and physical sciences.

"When the genius of man had discovered that it could combat Nature by her own means, it no longer rested; it watched her incessantly, and continually wrested from her new conquests, each marked by some improvement in his condition. Then succeeded, without interruption, meditating minds, which, being the faithful depositaries of acquired knowledge, and continually occupied with connecting and giving a vivifying unity to its parts, have led us, in less than four thousand years, from the first attempts of those pastoral observers to the profound calculations of Newton and Laplace, and to the learned classifications of Linnæus and Jussieu. This precious inheritance, always augmenting, borne from Chaldea to Egypt, from Egypt to Greece, hidden during periods of misfortune and darkness, recovered in a happier age, unequally dispersed among the nations of Europe, has been every where followed by riches and power; the nations which have welcomed it have become the mistresses of the world, while those which have neglected it have fallen into feebleness and obscurity."

Had man, in his original state, been cast feeble and naked on the surface of the globe, he could not have survived a single week, with all the elements of nature combined against him. His first experiment on the tiger or the asp, even his first morsel of food, might have been fatal to him. He must have been formed perfect in knowledge; or, being formed in ignorance and feebleness, he must have been protected by a power capable of controlling

the influences of surrounding nature. But before we proceed to offer a few remarks on the origin and progress of zoological science, it seems expedient to mark the subjects to which the attention of the naturalist is directed.

If we cast our eyes around, and survey, in a comprehensive manner, the objects which exhibit themselves to our view, we may form some idea of the occupations of those individuals who devote themselves to the examination of nature. The surface of the globe presents in part a vast expanse of water bounded by the sinuosities of the shores, and in part an undulating succession of plains and mountains. It is enveloped with an aërial fluid, which extends to a considerable height, sometimes transparent, and sometimes obscured with masses of floating vapour.

The land is diversified by slopes of every degree of inclination,—extensive plains, depressions and hollows, ridges and protuberances of various forms; the highest, however, bearing a very insignificant proportion to the earth's diameter. The waters, which cover more than two-thirds of the globe, separate the land into unequal portions, dividing it into continents and islands. Tracts of elevated ground traverse these in various directions, constituting the elongated mountain-groups named chains; which, being intersected by valleys and containing the sources of numberless streams, slope towards the adjacent countries. Other portions of the surface consist of irregularly-grouped eminences, of inferior height, interspersed with corresponding valleys. Elevated platforms are sometimes met with, and the plains and slopes are not unfrequently diversified with hills. The depressed parts of mountainous

regions present great diversity of form, extent, and direction, and often exhibit basins or hollows, which are occasionally filled with water.

Descending into the plains, we find that they are seldom perfectly level, but are formed into slopes of small inclination and of various extent. The pampas of South America, for example, stretch from the base of the Andes to Buenos Ayres, over a space of 900 miles; and in Africa are vast expanses of nearly level land, where the traveller, day after day, sees the horizon preserving the same distance as he proceeds, and bounding an ocean of arid sand. Large flats are also found at great elevations above the sea, such as those of Tartary, Thibet, and Mexico.

Of the other inequalities of the land, the more remarkable are the cavities forming lakes, and the grooves occupied by the beds of rivers. The former are of all sizes, from several hundred miles in circumference down to very small dimensions, and occur in all situations,—between mountain-chains, like the Caspian,—in plains, like Onega,—and along the course of rivers, like those of Canada. The streams necessarily flow in the line which marks the greatest depression of the valleys; although, in some instances, towards their mouths, they occupy a higher level, their beds having been raised by the deposition of the debris carried down by the torrent.

The bottom of the ocean, being merely the continuation of the surface of the land, may be supposed to present inequalities of a similar nature, although, owing to the action of currents, they are probably not so distinctly marked. The transition from what is above to that which is under the water is not in general denoted by any striking phenomenon, ex-

cepting the not unfrequent occurrence of long ranges of cliffs, pebbly beaches, and accumulations of sand. When the coast is low and flat, the depth of the sea in its vicinity is usually small; whilst along a rocky and abrupt shore it generally presents a depression in some measure corresponding to the height of the land. The existence of submarine chains of mountains is established by the numerous shoals and rocks which are to be considered as their summits. On these, coral reefs and islands have been gradually raised by myriads of zoophytes.

The mighty mass of waters, which is collectively termed the sea, occupies, as has been already mentioned, more than two-thirds of the surface of the globe. Its chemical composition, its tides, its currents, and all the varied phenomena which it presents, afford subjects of highly-interesting research.

The atmosphere, in like manner, which envelopes the earth, supplies, in its ever-varying aspects, its motions, its electrical phenomena, and the influence which it exercises on animal and vegetable life, an object of investigation pregnant with curious and useful knowledge.

The mysterious agency of subterranean fire has elevated great masses of rocky matter in various parts of the globe. Earthquakes have effected extensive and remarkable changes upon its surface; the waters of the ocean have alternately worn away the shores and eked them out by depositions of sand and mud; the rivers have furrowed the land, and carried the debris of the higher regions to the valleys and plains; while air and moisture have exercised their decomposing influence upon the hardest substances. By the action of these powers the earth

has become a fit receptacle for the varied forms of animal and vegetable existence with which we see it so profusely stored.

The variable distribution of heat has produced a striking effect in modifying the earth's surface. The cold of the polar regions covers them at all seasons with an extensive deposite of snow and ice, the margins of which are periodically dissolved by the increasing warmth of summer, to be repaired during the succeeding winter. The numberless icebergs, originally formed on the land or in its vicinity, floating on the ocean, and drifted by winds and currents, often pass into more genial regions, producing occasional variations of temperature. The elevated ridges of mountains experience a similar degree of cold, and in all climates, even in the torrid zone, are covered towards their summits with perennial snow.

Limited as are our powers of examining the interior of the globe, we yet find in its crust indications of a power which, by operating so as to produce apparent confusion, has effected results highly beneficial to the beings by whom the earth has been peopled. The strata, at first regularly superimposed upon each other, and consisting of those diversified materials which are supplied by the disintegration of pre-existing rocks, have been broken up, and inclined in every possible degree, so as to form those depressions and elevations which we every where observe on the surface. These inequalities have been increased by the protrusion of masses from the more central regions, and the whole has been subjected to the agency of powerful currents of water, by means of which the angular cavities and projec-

tions have been smoothed or filled up. The consideration of these phenomena constitutes a distinct branch of natural science.

The mountains, rocks, and strata, are composed of ingredients which in themselves are worthy of examination, and capable of affording intense interest. The extremely-diversified forms which these substances assume, their various properties, their uses in the economy of nature, and the purposes to which they may be applied by man, render their investigation not less useful than pleasant.

A most extensive and delightful field of observation presents itself to us in the vegetable bodies with which the surface of the land, and even the depths of the ocean, are so profusely furnished. The various regions of the globe are not less characterized by the form and grouping of the plants which have been allotted to them, than by the comparative activity of their vegetating power. The wastes of Europe, covered by ling, heaths, rushes, and sedges, exhibit little change of aspect under the variations of temperature and the revolutions of the year; while the plains of Venezuela, which during the drought are covered with a layer of sand, and present only a few withered palms scattered along the margins of muddy pools, are converted in the rainy season into an ocean of luxuriant vegetation. In the equinoctial regions of the globe, palms, arborescent ferns, and a multitude of magnificent trees, intertwined with flowering lianas hanging in festoons, form themselves into impenetrable forests, whereas the frigid regions of the arctic circle hardly produce plants a foot in height. The solemn and stately pines of the north of Europe have a very different

aspect from the slender-twigged beeches and chestnuts of its temperate regions, or the laurels and fan-palms of its southern shores.

Viewed in relation to their productions, the gelid regions of the globe are not confined to the circumpolar zone, but extend along the summits of the lofty mountains, following the line of perennial snow, which rises from the level of the sea, in Greenland and Spitzbergen, to the height of 14,000 feet in the Andes. These steril tracts nourish only a few species of plants, although the individuals belonging to them are frequently numerous. In the valleys, and on the southern slopes, no sooner has the returning heat of summer melted the snow, than a beautiful carpeting of verdure, diversified by flowers of various tints, spreads over the soil, displaying an astonishing rapidity of development, while the rocks in many places appear covered with cryptogamic plants. Besides mosses, lichens, and other inferior tribes, multitudes of ferns make their appearance. Grasses and creeping dicotyledonous plants are fully matured; and a rich pasturage affords, during the warm season, abundant nourishment to herbivorous animals. Some trees of small size also appear here and there, or even form themselves into thickets and woods. But, in general, the vegetation of these dreary regions, placed on the limits of the habitable earth, is characterized by a paucity of species and a stunted growth.

Firs and pines, existing in vast numbers, and retaining a perpetual though gloomy verdure, characterize the transition from the frigid to the northern temperate zone. This last extends from the parallels of 50° to 40° north latitude; and in its southern borders, the beech, the lime, and the chestnut, mingle

with the trees peculiar to more southern regions. The meadows and pastures, especially those in the vicinity of the sea and in the mountain-valleys, are clothed with a brilliant verdure, which we in vain look for in the other sections of the globe.

The warm temperate zone, extending to 25°, presents in general a less beautiful vegetation; for although the heat is greater the humidity is less constant. But it is in the torrid latitudes that Nature displays all her magnificence. There the species of tribes, which in other climates are herbaceous, become shrubs, and the shrubs trees. Ferns rise into trunks equal to those of pines in the northern regions of Europe; balsams, gums, and resins, exude from the bark; aromatic fruits and flowers abound; and the savage, as he roams the woods, satisfies his hunger with the spontaneous offerings of the soil. Here also are all the climates of the globe, and almost all their productions united; for, while the plains are covered with the gorgeous vegetation of the tropics, the lofty mountains display the forms that occur in the colder regions, and the places intermediate in elevation all the graduated transitions from these to the warmest parallels.

The vegetation of the seas presents much less diversity than that of the land. It is less luxuriant, less elegant, less ornamented, and less productive of substances directly useful to man. There is also less distinction between marine plants of different latitudes; for the great currents of the ocean, and other causes, render its temperature more equable than that of the atmosphere.

The numerous and diversified forms which plants assume, their distribution over the globe, their

various qualities and uses, and their internal organization, are subjects which have long occupied the attention of observers. In their reproduction, growth, and maturation, phenomena are presented to us, which are well calculated to excite our admiration; and the curious and diversified apparatus of tubes and cells, in which are circulated the fluids derived from the atmosphere and the earth, although apparently more simple than that of the animal economy, affords a profound as well as an interesting subject of research.

All parts of the earth's surface, even the deep recesses of caves and mines, the snows of the polar and alpine regions, and the bottom of the sea, are more or less covered with plants. The same may be said respecting animals, which, being much more diversified in their forms and internal structure, and endowed with more wonderful faculties, lead the mind, by the contemplation of their mechanism and habits, to a nearer approach to the great Creator of all things.

From the gigantic elephant that roams among the splendid forests of the warmer regions of the earth, the unwieldy hippopotamus that plunges in the pools and marshes of the African wilds, and the timid and graceful giraffe that bounds over the sandy desert, down to the little dormouse that we find slumbering in its winter retreat, to the lemming that in congregated myriads overruns the fields of the North, or to the mole that burrows under our feet, we find an astonishing variety of beings, exhibiting forms, instincts, passions, and pursuits, which adapt them for the occupation of every part of the globe. The woods, the plains, the

mountains, and the sands of the sea, are replete with life. The waters, too, whether of the ocean or of the land, teem with animated beings. Scarcely is a particle of matter to be found that does not present inhabitants to our view; and a drop of ditch-water is a little world in itself, stored with inmates of corresponding magnitude.

The consideration of the anatomical structure and external conformation of the many thousands of living creatures that come under our view, would of itself occupy many volumes, were it presented in detail; and even the simplest outline in which it could be produced would require more space than can be devoted to it here. All departments of Nature are full of wonders; but this excels the rest in interest, and is proportionally more difficult to be studied; although men, contented with superficial knowledge, may fancy themselves masters of her secrets when they have merely learned to distinguish some hundreds of objects from each other.

Man, separated from all other animals by peculiarities of corporeal organization, not less than by those intellectual faculties which are not in any considerable degree participated by the other inhabitants of the globe, and who is capable of subsisting in every climate, from the arid regions of the torrid zone to the frozen confines of the poles, also belongs in some measure to the study of nature. But the consideration of man includes a multitude of subjects that do not properly belong to Natural History, in the limited sense in which we use the term. It might even be said that it embraces all human knowledge. Thus, the constitution of the human mind, and the structure of the human body, as well as its healthy

and morbid phenomena, together with the means of regulating the former and of counteracting the latter, may certainly be included in it.

Natural history, however, in its more limited acceptation, may be considered as comprehending the three great kingdoms of Nature,—the mineral, the vegetable, and the animal,—the sciences treating of which are named Mineralogy, Botany, and Zoology. The first of these departments of knowledge comprehends, along with the consideration of simple minerals, that of the masses produced by the aggregation of these substances, and the changes effected upon them by natural causes. Botany teaches us to distinguish and arrange the subjects of the vegetable kingdom, points out the forms and functions of their organs, investigates their internal structure, traces them in their distribution over the surface of the globe, and makes known the various properties which render them noxious or useful to us. Zoology treats of the various tribes of animals, marks their external forms, compares their various organs, describes their habits, discloses the laws which regulate their distribution over the continents and islands, arranges them into families according to principles deduced from their structure, and in general makes us acquainted with all that belongs to their history. Although it is unnecessary here to offer any extended remarks on the cultivation of the vast field which is thus opened up to us, yet, the science of animals being intimately connected with the Series of Lives which we propose to offer to the public, it may not be improper to give a short account of its origin and progress.

In the History of Zoology, four eras are marked by

the names of four great cultivators of that science. All knowledge of nature must have commenced in the observation of individuals, or in an intuitive perception of their properties bestowed upon the first man. We may suppose, however, that at some period not remote from the creation of the human race men were left to their own resources, when they were necessarily forced to examine the nature and qualities of plants and animals, as well as of all natural objects with which they came into contact. The son would learn from the father, and impart to his descendants a certain degree of knowledge acquired by observation. Where the art of writing was unknown, science would advance but slowly; and even where it was practised, the privilege would probably belong to individuals or families, so that the mass would still be left to their ordinary resources. Those who lived in the remote ages antecedent to the Christian era probably knew as much of natural history as the unlettered peasant of our own age and country. Whatever may have been the acquirements of the priests, the sole depositaries of science in ancient India, Chaldea, and Egypt, they perished amid the revolutions of empires. The Sacred Scriptures, however, show that Moses, who was learned in all the wisdom of the Egyptians, had bestowed considerable attention on the animal world; but as these writings were not intended for our instruction in natural knowledge, the observations which they contain on the subject have no reference to systematic arrangement. In short, whatever may have been the knowledge possessed by the subjects of the Pharaohs, or the Hebrews and Greeks of the earlier ages, we do not find that it had assumed

any definite form, or constituted a body of doctrine, until the time of Alexander the Great. At this epoch the illustrious Aristotle collected the observations of his predecessors; added to them those, more extensive and more important, which were made by himself; and, although deeply engaged in the study of other subjects, succeeded in collecting a mass of facts, and in eliciting from them general principles, the accuracy of many of which might surprise us, did we not reflect that, in this department at least, he followed the true method by which the physical sciences have in our times received so vast an augmentation. He, however, stands alone among the writers of remote antiquity in this field; for, if others followed in his steps, their works have been lost.

Among the Romans, by whom the sciences were carried from Greece to Western Europe, there must have been many naturalists of considerable attainments; but the only writer of that nation whose descriptions have come down to us is Pliny the Elder, who flourished under Vespasian. His books on natural history are compiled from the writings of others, and may be considered as a general collection of all that was known in his time. Although he must have possessed opportunities of observing the many rare animals that were brought from all parts of the world to Rome, it does not appear that, by original observation, he added much to the mass of facts; still he may be viewed as marking the second epoch in the history of zoology, more especially as his works supplied the materials out of which naturalists in later ages have constructed their systems. As to Ælian, a Greek writer, whose treatise was also a

compilation, his merits were much fewer, and his absurdities more numerous than those of his predecessor. Both were fond of the marvellous, but he was eminently addicted to falsehood.

During the long ages of barbarism that succeeded the destruction of the Roman empire all the sciences were lost. On the revival of learning some feeble efforts were made to rescue natural history from its degraded condition; and at the commencement of the sixteenth century appeared several works on fishes, by Paolo Giovio, Pierre Belon, Rondelet, and Salviani. Belon wrote on birds also, and his observations are remarkable considering the period at which he lived. Conrad Gesner, a physician of Zurich, in his History of Animals, presented a compilation, arranged in alphabetical order, of all that the ancients had left on the subject; and Aldrovandi, after the labour of sixty years, left behind him an immense work on natural history, comprising no less than fourteen folio volumes. In the seventeenth century, we find our own Ray and Willughby among the most successful students of nature. Besides these celebrated individuals, there were others, such as Jonston and Redi, who laboured in the field of zoology; but perhaps the most original authors of this period were Swammerdam and Reaumur, whose minute observations, in entomology especially, have not been excelled in accuracy by those of any subsequent writers. It was not, however, until the middle of the eighteenth century, that a new era was formed by the labours of Linnæus, who was the first to collect all the known productions of nature, to class them according to simple principles derived from the observation of

facts, and to invent a nomenclature at once efficient and comprehensive.

Since the time of that philosopher natural history in all its branches has been cultivated with extreme ardour. The writers of this period have been numerous beyond those of any former epoch; and as anatomical investigation was successfully applied to the study of zoology, while the objects known were immensely increased, it was soon found that the classifications of the great reformer of the science were in many respects deficient, and that he had frequently associated objects which have too little affinity to be grouped together in the same class or order. The Systema Naturæ, in place of forming a complete catalogue of all the objects of nature, "became," to use the words of an accomplished author, "a mere sketch of what was to be done afterwards. Even more recent naturalists touched with a timid hand upon the natural grouping of the highest branches of the science, and it was reserved for a mighty genius of our own time to open the path to us, and to smooth the difficulties of that path, by precisely determining the limits of the great divisions, by exactly defining the lesser groups, by placing them all according to the invariable characters of their internal structure, and by ridding them of the accumulations of synonymes and absurdities which ignorance, want of method, or fertility of imagination, had heaped upon them."* This "mighty genius," it is almost unnecessary to add, was the illustrious Cuvier, who, although by no means the only great, and possibly not even the

* Mrs R. Lee's Memoirs of Baron Cuvier, p. 51.

greatest zoologist of his time, may, if we are disposed to mark an epoch by a single name, be selected for that purpose. But even this celebrated writer has, in his Règne Animal, merely presented a sketch, leaving to others the task of completing the various departments. They who think otherwise forget that the generic and specific characters of the systematist, necessarily condensed, are very inadequate to convey any other than the most superficial knowledge of the diversified objects of nature.

These, then, were the men who progressively reared the structure of zoology. Aristotle was a universal genius; but with respect to natural history he is to be looked upon chiefly as a zoologist. Pliny was a collector of every thing known in his time, whether true or fabulous, that related to animals, minerals, and plants. Linnæus arranged all the objects of nature. He was perhaps greater as a zoologist than as a botanist, although, in the latter capacity, his labours have been more highly appreciated, because there have been more cultivators of the science of plants, of which the study requires less laborious investigation, and to many persons is more attractive. Lastly, Cuvier, an original genius, an acute observer, and an accurate reasoner, profiting by the accumulated knowledge of ages, remodelled the system of zoology, and, in his Règne Animal, arranged the series of animals according to principles elicited from the investigation of their structure and relations.

The present volume includes the lives of the more eminent zoologists, from Aristotle to Linnæus. Those who succeeded the latter will furnish ample materials for another.

It is scarcely necessary to remark, that these volumes may either be considered as complete in themselves, or as introductory to a general and particular description of the various tribes of animals. A work on this most extensive subject is a great desideratum in English literature,—not that books on this department of science are wanting, but because we have none that present a continuous view of the families and species of the different classes, at once intelligible to the student of nature, attractive to the general reader, and free from that meagreness of phraseology necessarily peculiar to the composers of systematic catalogues.

It is not now required of us to point out the advantages that might result from the establishment of natural history as a branch of popular education. These advantages have been repeatedly pressed on the notice of the public; and, although the system has not been as yet adopted, the time cannot be far distant when the elements of mineralogy, botany, and zoology shall be taught in our schools, along with those branches of knowledge which at present occupy the field, to the exclusion of others not less adapted for the improvement of the youthful mind. "To constitute such pursuits a prominent part of elementary education," says a popular writer, "would without doubt be erroneous: it is, however, certain that none are more eminently fitted to fill the minds of youth with admiration of the numerous contrivances and proofs of design afforded in every part of the creation, and to inspire them with exalted conceptions of the Supreme Being."* We are

* Quarterly Review, vol. xxxvi. p. 219.

of opinion, notwithstanding, that they ought to occupy a distinct place in elementary education, because they possess many important recommendations, of which those mentioned are certainly not the least. The study of nature may be pursued in any degree, as a relaxation from other studies, as a pleasing occupation invigorating alike to the mind and the body, or as a science capable of calling into action the noblest faculties of man, and of affording employment to intellects of even a higher order than any of those who have hitherto acquired distinction in the walks of literature. Natural history has already to boast of an Aristotle, a Ray, a Reaumur, a Linnæus, a Haller, a Hunter, and a Cuvier. What other science can rank abler men among its cultivators? And, as is remarked by one of the most eminent naturalists that this country has produced, the late president of the Linnæan Society, "How delightful and how consolatory it is, among the disappointments and anxieties of life, to observe science, like virtue, retaining its relish to the last!"

ARISTOTLE.

SECTION I.

Remarkable Events in the Life of Aristotle.

Introductory Remarks—Birth and Parentage of Aristotle—He studies Philosophy under Plato—Is highly distinguished in the Academy—Retires to Atarneus on the Death of his Master—Marries—Is invited by Philip to superintend the Education of Alexander—Prosecutes his Studies at the Court—On the Succession of Alexander, returns to Athens, where he sets up a School in the Lyceum—Corresponds with Alexander, who supplies Means for carrying on his Investigations—Alexander finds Fault with him for publishing some of his Works, and after putting Callisthenes to Death, exalts his Rival Xenocrates—On the Death of Alexander, he is accused by his Enemies of Impiety, when he escapes to Chalcis, where he dies soon after—His personal Appearance and Character—His Testament—History of his Writings—Great Extent of the Subjects treated of by him—His Notions on elementary Bodies—The Material Universe—The Changes to which the Earth has been subjected, and the Eternity of its Existence—Conclusion.

NATURAL HISTORY, considered as a science or body of doctrine, commenced with Aristotle, the founder of the Peripatetic School, and one of the most illustrious philosophers of antiquity. His writings were held in the highest estimation by his own countrymen the Greeks, as well as by the Romans: they were considered as the most authentic sources of knowledge, after the revival of learning in Europe; and even at the present day their influence may be traced in the works of many who have not

so much as bestowed upon them a cursory glance. It is therefore fit that we should begin our biographical sketches with that celebrated author, the more especially as he did not confine himself to a single branch of natural history, but, like all great minds, possessed an extensive acquaintance with objects of various classes. It is he only, whose comprehensive glance seizes upon what is common to numerous tribes, that can duly estimate what ought to be considered as distinctive of a particular group, or can form rules for the arrangement and description of the beings which compose it. The three greatest naturalists whom the world has produced, Aristotle, Linnæus, and Cuvier, were men whose conceptions were enlarged by the most expanded views. Others have excelled them in particular departments, but none have equalled them in general knowledge.

Aristotle was born at Stagira, a city of the Thracian Chersonesus, in the first year of the 99th Olympiad, or the 384th before the Christian era. His father, Nicomachus, was physician to Amyntas, king of Macedonia, the father of Philip, and grandfather of Alexander the Great. Of his mother, we only know that her name was Phestis, and that, like her husband, she was originally from Chalcis. His family claimed descent from Machaon, the son of Esculapius. Having lost his parents at an early age, he went to reside with Proxenus, a citizen of Atarneus in Mysia, the friend to whose guardianship he had been left. According to some authorities, not being observed very strictly by those who had the immediate charge of his education, he spent a great part of his youth in licentious indulgences, by which he dissipated nearly the whole

of a large patrimony. It is also said that he entered into the military profession, but finding it disagreeable soon renounced it, and, as a means of subsistence, sold medicines at Athens. But most of these reflections on his juvenile character may perhaps be attributed to slander.

However this may be, it became necessary for him to choose an employment; and, on going to Delphi to consult the oracle, he was directed to proceed to Athens, and apply himself to the study of philosophy. This he accordingly did, and at the age of seventeen commenced his career as a pupil of Plato.

Being of an ardent temperament, he addicted himself to his new pursuit with so much energy, that he determined to reduce his hours of repose to the smallest possible limits. For this purpose he placed a metallic basin beside his couch, and on lying down held out one of his hands with an iron ball in it, that the noise produced by the collision might awake him should he happen to slumber. Such intensity of application, in a penetrating and subtile mind, could not fail to render him highly successful in his studies. We accordingly find that he had not been long in the academy when he was distinguished above all the other scholars; and it is said that Plato used to call him the *mind* of his school, and to compare him to a spirited colt that required the application of the rein to restrain its ardour.

He has been accused of disrespect and ingratitude to his aged master, and with having set up a school in opposition to him. The author of this charge was Aristoxenus, his own pupil; but it is well known that he was personally an enemy to Aristotle, because that philosopher, in choosing a

successor, had preferred Theophrastus. It is doubted, besides, whether he taught publicly until after Plato's death, which happened in 348 B. C.

Speusippus, the nephew of the sage just named, having been appointed to succeed him in his school, Aristotle, retiring from Athens, went to reside with Hermeias, governor of Assus and Atarneus in Mysia. Here he remained three years; but his friend having been executed, by command of Artaxerxes, as a rebel against Persia, he was obliged to seek refuge in Mytelene, taking with him Pythias, the kinswoman and adopted daughter of Hermeias, to whose memory he afterwards erected a statue in the temple of Delphos. This lady, endeared to him by the gratitude which he felt towards her father, and by the distress to which she had been reduced by his death, he married in the thirty-seventh year of his age. She died, however, soon after their union, leaving an infant daughter, who received the same name.

A short time having elapsed, he was invited by Philip to superintend the education of his son. This distinction he no doubt owed in part to his previous intimacy with the King of Macedonia; but it must also have arisen from the great celebrity which he enjoyed, as excelling in all kinds of science, and especially in the doctrine of politics. Alexander had attained the age of fifteen when the management of his studies was confided to Aristotle, then in his forty-second year. There is ground, however, for presuming that previous to this period the philosopher had been consulted respecting the instruction of the young prince.

The master, it has been said, was worthy of his

pupil, and the pupil of his master. In our opinion the master was worthy of a better pupil, and the pupil might have had a better master. At all events, Alexander, who was ambitious of excelling in every pursuit, must have profited greatly in the acquisition of knowledge by the lessons of the most eminently-endowed philosopher of his age. According to Plutarch and Aulus Gellius, he was instructed by him in rhetoric, physics, ethics, and politics; and so high was the estimation in which he held his preceptor, that he is said to have declared, that "he was not less indebted to Aristotle than to his father; since if it was through the one that he lived, it was through the other that he lived well." It is also supposed that he had been initiated in the abstruse speculations respecting the human soul, the nature of the Divinity, and other subjects, on which his master had not yet promulgated his notions to the world.

During his residence at the court of Macedonia, Aristotle did not exclusively devote himself to his duties as instructor of the young prince, but also took some share in public business, and continued his philosophical researches. For the latter purpose Philip is said to have granted him liberal supplies of money. In consideration of his various merits the king also rebuilt his native city, Stagira, which had been destroyed in the wars, and restored it to its former inhabitants, who had either been dispersed or carried into slavery.

Alexander had scarcely completed his twentieth year when the assassination of his father, by Pausanias, one of the officers of the guard, called him to the throne. Aristotle, however, continued to re-

side at the court two years longer; when some misunderstanding having arisen, he left the young monarch at the commencement of his celebrated expedition into Asia, and returned to Athens. It has been alleged that he accompanied his former pupil as far as Egypt; but the fact is not certain, although circumstances would seem to render it probable.

He was well received at Athens, on account of the benefits which Philip had conferred; for his sake, on the inhabitants of that city; and, obtaining permission from the magistrates to occupy the Lyceum, a large enclosure in the suburbs, he proceeded to form a school. It was his custom to instruct his disciples while walking with them; and for this reason the new sect received the name of Peripatetics, or walking philosophers. In the morning he delivered his acroatic lectures to his select pupils, imparting to them the more abstruse parts of metaphysical science; and in the evening gave to his visiters or the public at large exoteric discourses, in which the subjects discussed were treated in a popular style. As the Lyceum soon acquired great celebrity, scholars flocked to it from all parts of Greece. Xenocrates, who shared with him the lessons of Plato, had by this time succeeded Speusippus in the Academy, and it has been alleged that Aristotle established his seminary in contemptuous opposition; observing, that it would be shameful for him to be silent while the other taught publicly. But although the rival sages of those days cannot be supposed to have been influenced by a gentler spirit than animates those of our own times, there is no reason for attributing to the Stagirite in this matter any other motive than a

laudable desire of seeking his own interest by communicating knowledge to those who were desirous of receiving it.

In this manner he gave public lectures at Athens thirteen years, during the greater part of which time he did not cease to correspond with Alexander. That celebrated prince had placed at his disposal several thousand persons, who were occupied in hunting, fishing, and making the observations which were necessary for completing his History of Animals. He is moreover said to have given the enormous sum of 800 talents for the same purpose; while he also took care to send to him a great variety of zoological specimens, collected in the countries which he had subdued.

The misunderstanding which had begun before Aristotle parted from his royal pupil, but which had not prevented the good offices of the latter, increased towards the end of his career. One of the first occasions seems to have been offered by the philosopher, who, having published his works on physics and metaphysics, received from Alexander, who was piqued at his having divulged to the world the valuable knowledge which he had obtained from him in his youth, the following letter:—

"Alexander to Aristotle, wishing all happiness. You have done amiss in publishing your books on the speculative sciences. In what shall I excel others if what you taught me privately be communicated to all? You know well that I would rather surpass mankind in the more sublime branches of learning than in power. Farewell."

This epistle exhibits the king as a very exclusive personage; and, joined to what history has recorded of his actions, tends to show that selfishness, however refined or disguised, was the main source of his insatiable ambition. One of the sincerest pleasures of a great mind is to communicate to others all the blessings that it possesses. On other occasions he appeared to entertain a wish to mortify the philosopher by exalting his rival Xenocrates, who had nothing to recommend him besides a respectable moral character. It has even been asserted by some, that the conqueror, after he had put Callisthenes to death, intended the same fate for Aristotle.

This Callisthenes was a kinsman and disciple of the other, through whose influence, it is said, he was appointed to attend the king on his Asiatic expedition. His republican sentiments and independent spirit, however, rendered him an indifferent courtier; while his rude and ill-timed reflections finally converted him into an object of suspicion or dislike. The conspiracy of Hermolaus affording Alexander a plausible pretext for getting rid of his uncourtly monitor, he caused him to be apprehended and put to death. Some say that he was exposed to lions, others that he was tortured and crucified; but, in whatever way he met his end, it is generally agreed that his life was sacrificed to gratify the enmity of his sovereign. Aristotle naturally espoused the cause of his relative, and from that period harboured a deep resentment against his destroyer. It has even been alleged that he was privy to the supposed design of murdering the victorious prince; but of this there is no satisfactory evidence.

Notwithstanding the coolness which thus existed

between "Macedonia's madman" and "the Stagirite," the latter continued to enjoy at least an appearance of protection, which prevented his enemies from seriously molesting him. But as the splendour of his talents, his success in teaching, and the celebrity which he had acquired in all parts of Greece, had excited the animosity of those who found themselves eclipsed by the brightness of his genius, no sooner was Alexander dead, than they stirred up a priest, named Eurymedon, with whom was associated Demophilus, a powerful citizen, to prefer a charge of impiety against him before the court of Areopagus, on the ground that he had commemorated the virtues of his wife and of his friend Hermeias with such honours as were exclusively bestowed on the gods. Warned by the fate of Socrates under similar circumstances, he judged it prudent to retire; remarking, that he wished to spare the Athenians the disgrace of committing another act of injustice against philosophy.

He effected his escape, with a few friends, to Chalcis in Eubœa, where he died soon after, in the year 322 B.C., and the 63d of his age; having, on his deathbed, appointed Theophrastus of Lesbos, one of his favourite pupils, his successor at the Lyceum. Various accounts are given of his demise; but it is probable that an overexcited mind, and a body worn out by disease, were the real causes of his dissolution.

According to Procopius and others, Aristotle drowned himself in the Eubœan Euripus, because he could not discover the cause of its ebbing and flowing, which are said to take place seven times a-day. Sir Thomas Browne, in his Enquiries into Vulgar and

Common Errors, refutes this assertion on the following grounds:—In the first place, his death is related to have taken place in two ways by Diogenes Laertius; the one, from Eumolus and Phavorinus, that being accused of impiety for composing a hymn to his friend Hermeias, he withdrew to Chalcis, where he drank poison; the other, by Apollodorus, that he died of a disease in his stomach, in his sixty-third year. Again, the thing is in itself unreasonable, and therefore improbable; for Aristotle was not so apt to be vexed by the difficulty of accounting for natural phenomena, nor is there any evidence that he endeavoured to discover the ebb and flow of the Euripus, for he has made no mention of it in his works. Lastly, the phenomenon itself is disputable; and it appears from a comparison of testimonies on the subject, that the stream in question flows and ebbs only four times a-day, as is the case with other parts of the sea, though it is subject to irregularities dependent upon the winds and other causes. "However, therefore, Aristotle died," concludes our author, "what was his end, or upon what occasion, although it be not altogether assured, yet that his memory and worthy name shall live, no man will deny, nor gratefull schollar doubt: and if, according to the Elogie of Solon, a man may be onely said to be happy after he is dead, and ceaseth to be in the visible capacity of beatitude: or if, according unto his own Ethicks, sence is not essentiall unto felicity, but a man may be happy without the apprehension thereof; surely in that sence he is pyramidally happy, nor can he ever perish but in the Euripe of ignorance, or till the torrent of barbarisme overwhelme all."

With respect to personal appearance, Aristotle was not highly favoured. He was of short stature, with slender legs, and remarkably small eyes. His voice was shrill, and his utterance hesitating. Although his constitution was feeble, he seems to have enjoyed good health. His moral character has been impeached by some; but we may presume that it was not liable to any serious imputation, otherwise his faults would not have escaped the observation of his numerous enemies, who yet could only prefer against him some vague charges of impiety.

Aristotle was not merely a philosopher; he was also what would at the present day be called a gentleman and a man of the world. In accordance with this character he dressed magnificently, wore rings of great value, shaved his head and face, contrary to the practice of the other scholars of Plato, and freely indulged in social intercourse. He was twice married. By his first wife, Pythias, he had a daughter of the same name, who was married to Nicanor, the son of Proxenus. His second wife was Herpylis, a native of Stagira, by whom he had a son, called Nicomachus.

It is difficult to determine his real character. Those who seem to find pleasure in reviling him, assert that he was a parasite, a habitual glutton and drunkard, a despiser of the gods, a vain person, whose chief care was to ornament his person, and thereby counteract the unfavourable impression which his disproportioned figure might make. It has been said, with perhaps more truth, that he taught his pupil Alexander principles of morals and policy which were not the best adapted for a prince of his ambitious temper; and that his desire of standing

forth as the founder of a philosophical sect, induced him to prefer abstract disquisitions to solid knowledge, and to indulge in a spirit of contradiction and innovation. On the other hand, he has been extolled as a prodigy of knowledge and intellect, and represented as "the secretary of nature." Jews have laid claim to his philosophy as derived from Solomon, and Christians have held him up as a person ordained to prepare the way for a Divine revelation. It is certain, however, that he was a very remarkable individual, possessed of great powers of observation and discrimination, and one who, had he devoted himself to the study of natural objects with a sincere desire of ascertaining their properties and a resolution to adhere to truth, might have succeeded in laying on a solid basis the foundations of physical science.

Diogenes of Laertes in Cilicia, who lived about the end of the second century, and who wrote an account of the lives of the philosophers, has preserved his testament, the substance of which is as follows:—Antipater, the regent of Macedonia, is appointed his executor. To his wife Herpylis he leaves the choice of two houses, the one in Chalcis, the other at Stagira. He commends her domestic virtues, and requests his friends to distinguish her by the kindest attention. To Nicomachus, his son by Herpylis, and to Pythias, his daughter by his first wife, he bequeaths the remainder of his fortune, excepting his library and writings, which he leaves to Theophrastus. He desires that his daughter shall be given in marriage to Nicanor, the son of his benefactor Proxenus, or, should he not be inclined to receive her, to Theophrastus, his es-

teemed pupil. The bones of Pythias he orders to be disinterred and buried with his own body, as she herself had desired. None of his slaves are to be sold; they are all either emancipated by his will, or ordered to be set free by his heirs whenever they shall become worthy of liberty. Finally, he orders that the dedications which he had vowed for the safety of Nicanor be presented at Stagira to Jupiter and Minerva.

The same writer gives the titles of 260 works of Aristotle. Many of these, however, have perished. From his situation in society, and the munificent patronage of Alexander, he possessed more ample resources than any other man of science that could be named; and, considering the age in which he lived, his success in the investigation of nature may be considered as almost unrivalled. It is to be regretted that so many of his treatises have been lost, and that even those which have been transmitted to us have not been preserved in a perfect state.

Strabo has given a melancholy history of these works, in the ninth book of his geography. Aristotle, as we have stated above, had bequeathed them to Theophrastus, the most distinguished of his pupils, and his successor in the school. That philosopher left them, together with his own works, to his scholar Neleus, who carried them to his native city, Scepsis in Asia Minor. The heirs of Neleus, who were unlettered men, kept them locked up; and when they understood that the King of Pergamos, to whom the town belonged, was collecting books, to form a library on the plan of the Alexandrian, they concealed them in a vault or cellar, where they lay forgotten 130 years. When acci-

dentally discovered, at the end of that period, they were found to be greatly injured by damp and vermin. At length they were sold to an inhabitant of Athens, named Apellicon, who, however, was not so much a lover of philosophy as a collector of manuscripts, and who adulterated the original text by his injudicious emendations and interpolations. Several copies thus altered were published by him. When Athens was taken by Sylla, the library of this citizen was carried to Rome, where the works of Aristotle were corrected by Tyrannion, a grammarian. Andronicus of Rhodes afterwards arranged the whole into sections, and gave them to the world.

According to Dr Gillies, Aristotle must have "composed above 400 different treatises, of which only forty-eight have been transmitted to the present age. But many of these last consist of several books; and the whole of his remains together still form a golden stream of Greek erudition, exceeding four times the collective bulk of the Iliad and Odyssey."

He was scarcely less ambitious than his pupil Alexander, and his works embrace nearly the whole range of human knowledge as it existed in his day. He was the inventor of the syllogistic mode of reasoning, the principles of which he lays down in his work on logic. In his books on rhetoric, he has investigated the principles of eloquence with great accuracy and precision, insomuch that they form the basis of all that has since been written on the subject. His work on poetics, or rather the fragment which has come down to us under that name, although almost entirely confined to the consideration of the drama, contains principles applicable to

poetical composition in general, and is equally distinguished for precision and depth of thought. Those on ethics and politics are also remarkable productions; and although the former has been effectually superseded by a more perfect system, the latter contains much that is interesting even at the present day. In his metaphysics, he expounds the doctrine of Being abstracted from Matter, and speaks of a First Mover,—the life and intellect of the universe, eternal and immutable, but neither omnipresent nor omnipotent. When treating of physics, he does not in general lay down rules *a priori*, but deduces them from the observation and comparison of facts. This being the case, we might expect that such of his writings as relate to natural history should contain much truth.

He holds that all terrestrial bodies are composed of four elements,—earth, water, air, and fire. Earth and water are heavy, because they tend towards the earth's centre; while air and fire, which tend upwards, are light.

Besides these four elements, he has admitted a fifth, of which the celestial objects were composed, and whose motion is always circular. He supposed that there is above the air, under the concave part of the moon, a sphere of fire to which all the flames ascend, as the brooks and rivers flow into the ocean.

He maintains that matter is infinitely divisible; that the universe is full, and that there is no vacuum in nature; that the world is eternal; that the sun, which has always revolved as it does at present, will for ever continue to do so; and finally, that the generations of men succeed each other without having had a beginning or foreseeing an end.

He alleges that the heavens are incapable of decay; and that although sublunar things are subject to corruption, their parts nevertheless do not perish; that they only change place; that from the remains of one thing another is made; and that thus the mass of the world always remains entire. He holds that the earth is in the centre of the world; and that the First Being makes the skies revolve round the earth, by intelligences which are continually occupied with these motions.

He asserts that all of the globe which is now covered by the waters of the sea was formerly dry land; and that what is now dry land will be again converted into water. The reason is this: the rivers and torrents are continually carrying along sand and earth, which causes the shores gradually to advance, and the sea gradually to retire; so that in the course of innumerable ages the alleged vicissitudes necessarily take place. He adds, that in several parts which are considerably inland, and even of great elevation, the sea, when retiring, left shells, and that, on digging in the ground, anchors and fragments of ships are sometimes found. Ovid attributes the same opinion to Pythagoras.

Aristotle farther remarks, that these conversions of sea into land, and of land into sea, which gradually take place in the long lapse of ages, are in a great measure the cause of our ignorance of past occurrences. He adds, that besides this other accidents happen, which give rise even to the loss of the arts; and among these he enumerates pestilences, wars, famines, earthquakes, burnings, and desolations, which exterminate all the inhabitants of a country, excepting a few who escape and save them-

selves in the deserts, where they lead a savage life, and where they give origin to others, who in the progress of time cultivate the ground, and invent or rediscover the arts; and that the same opinions recur, and have been renewed times without number. In this manner, he maintains that, notwithstanding these vicissitudes and revolutions, the machine of the world always remains indestructible.

If an apology were necessary for the brevity of the above sketch, it might be urged, that it probably contains all that is authentic respecting the life of this eminent philosopher; and that our object is to condense, not to expand; to direct the attention to characteristic features, not to lead the mind to expatiate vaguely upon the general surface.

SECTION II.

Account of Aristotle's History of Animals.

Aristotle's Ideas respecting the Soul—His Views of Anatomy and Physiology—Introduction to his History of Animals, consisting of Aphorisms or general Principles—His Division of Animals; their external Parts; their Arrangement into Families; their internal Organs; Generation, &c.

Of all the sciences, it has been remarked, that which owes most to Aristotle is the natural history of animals. Not only was he acquainted with numerous species, he also described them according to a comprehensive and luminous method, which perhaps none of his successors have approached; arranging the facts observed, not according to the species, but according to the organs and functions, which affords the only means of establishing comparative results. It may in fact be said, that besides being the oldest author on comparative anatomy whose writings we possess, he was likewise one of those who have treated that part of natural history with most genius, and best deserves to be taken as a model. The principal divisions which are still adopted by naturalists in the animal kingdom are those of Aristotle, and he proposed some which have been resumed after having been unjustly rejected. If we examine the foundation of these great labours, we shall find that they all rest on the same method,

which is itself derived from the theory respecting the origin of general ideas. He always observes facts with attention, compares them with great precision, and endeavours to discover the circumstances in which they agree. His style, moreover, is suited to his method: simple, precise, unstudied, and calm, it seems in every respect the reverse of Plato's; but it has also the merit of being generally clear, except in some places where his ideas themselves were not so.*

In one of his treatises, Aristotle divides natural bodies into those possessing life, and those destitute of that principle,—into animate and inanimate. He considers soul as the vital energy or vivifying principle common to all organized bodies; but distinguishes in it three species. Thus, in plants there is a vegetative, in animals a vegetative and a sentient, in man a vegetative, a sentient, and a rational soul. The functions of nutrition and generation in plants and animals he attributes to the vegetative soul; sense, voluntary motion, appetite, and passion, to the sentient soul; the exercise of the intellectual faculties, to the rational soul.

His ideas of anatomy and physiology were extremely imperfect. Thus, he supposed the brain to be a cold spongy mass, adapted for collecting and exhaling the superfluous moisture, and intended for aiding the lungs and trachea in regulating the heat of the body. The heart is the seat of the vital fire, the fountain of the blood, the organ of motion, sensation, and nutrition, as well as of the passions, and the origin of the veins and nerves. The blood is confined to the veins; while the arteries contain

* Biographie Universelle.

an aërial spirit; and by nerves he means tendons, nerves, and arteries,—in short, strings of all kinds, as the name implies. The heart has three cavities; in the larger animals it communicates with the windpipe, or the ramifications of the pulmonary artery receive the breath in the lungs and carry it to the heart. Respiration is performed by the expansion of the air in the lungs, by means of the internal fire, and the subsequent irruption of the external air to prevent a vacuum. Digestion is a kind of concoction or boiling, performed in the stomach, assisted by the heat of the neighbouring viscera.

It is perhaps impossible at the present day, when the investigation of nature is so much facilitated by the accumulated knowledge of ages in every department of physical science, by the commercial relations existing between countries in all parts of the globe, by a tried method of observation, experiment, and induction, and finally, by the possession of the most ingenious instruments, to form any adequate idea of the numerous difficulties under which the ancient naturalist laboured. On the other hand, he had this great advantage, that almost every thing was new; that the most simple observation correctly recorded, the most trivial phenomenon truly interpreted, became as it were his inalienable property, and was handed down to succeeding ages as a proof of his talents,—a circumstance which must have supplied a great motive to exertion.

The History of Animals is undoubtedly one of the most remarkable performances of which physical science can boast. It must not, however, be imagined that it is a work which, replete with truth and exhibiting the well-arranged results of accurate

observation and laborious investigation, is calculated to afford material aid to the modern student. To him more recent productions are the only safe guides; nor is it until he has studied them, and interrogated nature for himself, that he can derive benefit from the perusal of the treatise which we now proceed to examine.

The first book contains a brief description of the parts of which the bodies of animals are composed. The introduction consists of general propositions; of which we shall present a few of the more remarkable as a specimen.

Some parts, he observes, are simple, and divided into similar particles; while others are compound, and consist of dissimilar elements. The same parts in different animals vary in form, proportion, and other qualities; and there are many creatures which, although they have the same parts, have them in different situations. Animals differ in their mode of living, actions, and manners: thus, some reside on land, others in water; and of the latter some breathe water, others air, and some neither. Of aquatic animals, some inhabit the sea, others the rivers, lakes, or marshes. Of those which live in the sea, some are pelagic, others littoral, and others inhabit rocks. Of land-animals, some respire air, as man; others, although they live on the land and obtain their food there, do not breathe air, as wasps, bees, and other insects.

We know no animal, says he, that flies only, as the fish swims; for those which have membranous wings walk also; and bats have feet, as have seals, although imperfect. But some birds have the feet weak; in which case the defect is compensated by

the superior action of the wings, as in swallows. There are many species which both walk and swim. Animals also differ in their habits; thus, some are gregarious, others solitary,—a distinction applicable to them whether they walk, fly, or swim. Some obey a leader, others act independently; cranes and bees are of the former, ants of the latter kind. Some feed on flesh, others on fruits, while others feed indiscriminately; some have homes, others use no covering of this kind, but reside in the open air. Some burrow, as lizards and snakes; others, as the horse and the dog, live above ground. Some animals seek their food at night, others by day; some are tame, others wild; some utter sounds, others are mute, and some sing; all of them, however, sing or cry in some way at the season of pairing.

In this way he proceeds, stating briefly the various circumstances in which animals differ from each other, and in conclusion asserting that man is the only one capable of design; for, says he, although many of them have memory and docility, none but man have the faculty of reflection.

These general propositions or aphorisms are not so simple or so easily attained as one might imagine on reading them inattentively. Let any person who has a tolerably comprehensive idea of the series of animated beings reflect a little, and he will perceive, that such as the following must be derived from the observation of a great number of facts:—Those parts which seize the food, and into which it is received, are found in all animals. The sense of touch is the only one common to all. Every living creature has a humour, blood or sanies, the loss of

which produces death. Every species that has wings has also feet.

In this chapter Aristotle divides animals into such as have blood, and such as have it not. Of the former (the red-blooded) some want feet, others have two of these organs, and others four. Of the latter (the white-blooded) many have more than four feet. Of the swimming-animals, which are destitute of feet, some have fins, which are two or four; others none. Of the cartilaginous class, those which are flat have no fins, as the skate. Some of them have feet, as the mollusca. Those which have a hard leathery covering swim with their tail. Again, some animals are viviparous, others produce eggs, some worms. Man, the horse, the seal, and other land-animals, bring forth their young alive; as do the cetacea and sharks. Those which have blow-holes have no gills, as the dolphin and whale. In this department, the observations of the great philosopher are often minute, and generally accurate, although usually too aphoristic and unconnected to be of much use to the student.

Of flying-animals, some, as the eagle and hawk, have wings; others, in place of wings, have membranes, as the bee and the beetle; others a leathery expansion, as the bat. Those which have feathered or leathery wings are blooded (red-blooded); but those which have membranous wings, as insects, are bloodless (white-blooded). Those which fly with wings or with leathery expansions, either have two feet or none; for, says he, it is reported that there are serpents of this kind in Ethiopia. Of the flying bloodless animals, some have their wings covered by a sheath, as beetles; others have no covering,

and of these some have two, others four wings. Those which are of large size, or bear a sting behind, have four; but the smaller and stingless, two only. Those which have sheaths to their wings, have no sting; but those which have two wings are furnished with a sting in their fore part, as the gnat.

Animals are distinguished from each other, so as to form kinds or families. These, according to our author, are quadrupeds, birds, fishes, cetacea, all which he says have (red) blood. There is another kind, covered with a shell, such as the oyster; and another, protected by a softer shell, such as the crab. Another kind is that of the mollusca, such as the cuttle-fish; and lastly, the family of insects. All these are destitute of (red) blood.

Here, then, we have a general classification of animals, which it is important to notice, as we may have occasion afterwards to compare it with arrangements proposed by other naturalists. It may be reduced to the following form:—

Red-blooded Animals.

QUADRUPEDS, SERPENTS, BIRDS, FISHES, CETACEA.

White-blooded Animals.

TESTACEA, CRUSTACEA, MOLLUSCA, INSECTS.

It must, however, be understood, that Aristotle proposes no formal distribution of animals, and that his ideas respecting families, groups, or genera, such as those of our present naturalists, are extremely vague.

His quadrupeds include the mammalia and the quadrupedal reptiles. He divides them into those which are viviparous, and those which are oviparous; the former covered with hair, the latter with

scales. Serpents are also scaly, and, excepting the viper, oviparous. Yet all viviparous animals are not hairy; for some fishes, he remarks, likewise bring forth their young alive. In the great family of viviparous quadrupeds also, he says, there are many species (or genera), as man, the lion, the stag, and the dog. He then mentions, as an example of a natural genus, those which have a mane, as the horse, the ass, the mule, and the wild-ass of Syria, which are severally distinct species, but together constitute a genus or family.

This introduction to the History of Animals the philosopher seems to have intended, less as a summary of his general views respecting their organization and habits, than as a popular exordium, calculated to engage the attention of the reader, and excite him to the study of nature. Whatever errors it may contain, and however much it may be deficient in strictly methodical arrangement, it is yet obviously the result of extensive, and frequently accurate observation. He then proceeds to the description of the different parts of the human body, first treating of what anatomists call the great regions, and the exterior generally, and then passing to the internal organization. His descriptions in general are vague, and often incorrect. As an example, we may translate the passage that refers to the ear.

This organ, he says, is that part of the head by which we hear; but we do not respire by it, for Alcmeon's opinion, that goats respire by the ears, is incorrect. One part of it has no name, the other is called lobos; it consists entirely of cartilage and flesh. The internal region is like a spiral shell, resembling

an auricle at the extremity of the bone, into which as into a vessel the sound passes. Nor is there any passage from it to the brain, but to the palate; and a vein stretches from the brain to it. But the eyes belong to the brain, and each is placed upon a small vein. Every animal that has ears moves them, excepting man; for of those which are furnished with the sense of hearing, some have ears, others none, but an open passage; of which kind are feathered animals, and all that are covered with a scaly skin. But those which are viviparous, the seal, the dolphin, and other cetacea excepted, have external ears, as well as the viviparous cartilaginous animals. The seal has a manifest passage for hearing; but the dolphin, although it hears, yet has no ears. The ears are situated at the same level as the eyes, but not higher, as in certain quadrupeds. The ears of some persons are smooth, of others rough, or partly so; but this furnishes no indication of disposition. They are also large, small, or of moderate size, projecting, or flat, or intermediate. The latter circumstance indicates the best disposition. Large and projecting ears are indicative of a fool and babbler.

From this passage we perceive that Aristotle was acquainted with the Eustachian tube; although his anatomical knowledge of the ear is certainly of the most superficial kind, and his physiognomical notions respecting it sufficiently ludicrous. He divides the body into head, neck, trunk, arms, and legs, much as we do at the present day. The head consists of the calvaria, or part covered with hair, which is divided into three regions, the bregma or fore part, the crown, and the occiput. Under the bregma is the brain; but the back part of the

head is empty. When speaking of the face, he remarks, that persons having a large forehead are of slow intellect, that smallness of that part indicates fickleness, great breadth stupidity, and roundness irascibility. The physiognomists of our day have a different opinion. The neck contains the spine, the gullet, and the arteria (or windpipe). The trunk consists of the breast, the belly, &c.;—and in this manner he passes over the different external regions.

In describing the brain, he states that all red-blooded animals have that organ, as have also the mollusca, and that in man it is largest and most humid. He had observed its two membranes, as well as the hemispheres and cerebellum; but he asserts that it is bloodless, that no veins exist in it, and that it is naturally cold to the touch. He was ignorant of the distribution of the nerves, was not aware that the arteries contain blood, imagined that the heart being connected with the windpipe is inflated through it, and, in a word, manifests extreme ignorance of every thing that relates to the internal organization.

Judging from this specimen, the reader may suspect that his time would not be profitably employed in separating the few particles of wheat from the great mass of chaff which the writings of Aristotle present to us. Nor must it be concealed that the modern naturalist does not consult his volumes for information, but merely to gratify curiosity. There is to be found, indeed, in the most imperfect of our elementary works on anatomy, whether human or comparative, more knowledge than was probably contained in the Alexandrian library.

In his second book, he treats more particularly of

animals. At its commencement we unfortunately meet with a stumbling-block, in the shape of an assertion, that the neck of the lion has no vertebræ, but consists of a single bone. In speaking of limbs, he takes occasion to describe the proboscis of the elephant, and to enter generally into the history of that gigantic quadruped. He then speaks with reference to the distribution of hair, remarking, that the hair of the human head is longer than that of any other animal; that some are covered all over with long hair, as the bear; others on the neck only, as the lion; and others only along the back of the neck, as the horse and the bonasus. He describes the buffalo and the camel; of the latter of which he mentions the two species, the Arabian and the Bactrian. The subject of claws, hoofs, and horns, is next discussed. He states that some quadrupeds have many toes, as the lion; while others have the foot divided into two, as the sheep; and others again have a single toe or hoof, as the horse. His aphorisms on the subject of horns are in general correct. Thus, he states that most creatures furnished with them have cloven hoofs, and that no single-hoofed animal has two horns.

He then proceeds to speak of teeth, which he says are possessed by all viviparous quadrupeds. Some have them in both jaws, others not; for horned animals have teeth in the lower jaw only, the front ones being wanting in the upper. Yet all animals which have no teeth above are not horned; the camel, for example. Some have projecting teeth, as the boar; others not. In some they are jagged, as in the lion, panther, and dog; in others even, as in the horse and cow. No animal has horns and protruded

teeth; nor is there any having jagged teeth that has either horns or projecting teeth. The greater part have the front teeth sharp, and those behind broad; but the seal has them all jagged, for it partakes of the nature of fishes, which have that peculiarity. His remarks on the shedding of the teeth are in general erroneous. The elephant, he says, has four grinders, together with two others, the latter of which are of great size and bent upwards in the male, but small and directed the contrary way in the female. This circumstance Cuvier states to be correct with respect to the African variety, although the case is different in the Asiatic. His account of the hippopotamus, however, is inaccurate in almost every particular. Thus, he says it has a mane like a horse, cloven feet like an ox, and is of the size of an ass,—a description which answers better to the gnu. In speaking of monkeys, of which he mentions several kinds, he remarks their resemblance to the human species, and the peculiar formation of their hind feet, which may be used as hands.

He then gives a general account of the oviparous quadrupeds, particularly of the Egyptian crocodile and the chameleon, concerning which he relates many interesting circumstances.

In treating of birds, he remarks that they are bipedal, like man, destitute of anterior limbs, but furnished with wings, and having a peculiar formation in the legs. Those birds which have hooked claws, he says, have the breast more robust than others. He then describes the differences in the structure of their feet; remarking, that most of them have three toes before and one behind, although a few, as the wryneck, have two only before. Birds,

he adds, have the place of lips and teeth supplied by a bill; and instead of external ears and nostrils properly so called, they have passages for hearing and smelling in different parts of the head. The eyes have no lashes, but are furnished with a membrane like lizards. The other remarkable peculiarities, such as the feathers and the form of the tongue, are then mentioned. No birds, he observes, that have hooked claws are furnished with spurs. In his remarks on this family he is generally correct; though here, as elsewhere, he is not merely brief, but vague and superficial. His division of birds would seem to be the following:—Those with hooked claws; those with separated toes; and such as are web-footed.

Fishes are next discussed with nearly equal brevity. He remarks, that they have a peculiar elongated form, are destitute of mammæ, emit by their gills the water received at the mouth, swim by means of fins, are generally covered with scales, and are destitute of the organs of hearing and smelling.

His description of the internal parts of these tribes of animals contains a mixture of truth and error. This book terminates with remarks on the structure of serpents.

The third commences with observations on those parts of animals which are homogeneous, such as the blood, the fibres, the veins, the nerves, and the hair. Under the general title of nerve, he confounds the columnæ carneæ of the heart, the tendons and fasciæ; and it does not appear that he had any idea of what modern anatomists call nerves. In speaking of hair, he remarks that it grows in sick persons, especially those labouring under consumption, in old people, and even in dead bodies. The same

remark applies to the nails. The blood is contained in the veins and heart, is, like the brain, insensible, flows from a wound in any part of the flesh, has a sweet taste and a red colour, coagulates in the air, palpitates in the veins, and when vitiated is productive of disease. On the subject of milk, his observations deserve attention. Thus, he says that all viviparous animals which have hair are furnished with mammæ, as are also the whale and the dolphin; but those which are oviparous are not so provided. All milk has a watery fluid, called serum, and a thick part, called cheese; while that produced by animals which are destitute of fore teeth in the upper jaw coagulates. On this subject he mentions some curious circumstances. Some kinds of food occasion the appearance of a little milk in women who are not pregnant. There have even been instances of it flowing from the breasts of elderly females. The shepherds about Mount Œta rub the udders of unimpregnated goats with nettles, and thus obtain abundance of milk from them. It sometimes happens that male animals secrete the same fluid; thus, there was a he-goat in the island of Lemnos, which yielded so much that small cheeses were made of it. A little may be pressed from the breasts of some men after the age of puberty; and there have been individuals who on being sucked have yielded a large quantity. Instances of this have been recorded by other observers; and Humboldt met with a similar case in South America.*

In the fourth book, Aristotle treats of the animals

* See Edinburgh Cabinet Library, No. X. Travels and Researches of Alexander Von Humboldt, p. 91.

which are destitute of red blood. Of these, he says there are several genera: the mollusca, such as the cuttlefish, which is externally soft with an internal firm part; the crustacea, internally soft and covered with a firm integument, such as the crab; the testacea, internally soft and externally hard and solid, as the limpet and oyster. The insects form the fourth genus; and are distinguished by their being externally and internally formed of a hardish or cartilaginous substance, and divided into segments; some of them having wings, as the wasp; while others have none, as the centipede. He then gives a pretty full account of the cuttlefish and nautilus, treats of the crustaceous animals generally, and enters into details respecting the other two classes. After this he enumerates the organs of sensation, stating that man, and all the red-blooded and viviparous animals, possess five senses, although in the mole vision is deficient. He describes correctly the eye of that creature, showing that it is covered by a thickish skin, but presents a conformation similar to that of other animals, and is furnished with a nerve from the brain. He shows that although fishes have no visible organs of smelling or hearing, they yet possess both senses, and, in treating of this subject, states many interesting facts relative to the mode employed in catching dolphins. He also shows that insects have the faculty of hearing and smelling. The testacea, he says, besides feeling, which is common to all animals, have smell and taste; but he also asserts that some of them, the solen and pecten, are capable of seeing, and others of hearing.

All viviparous quadrupeds not only sleep, but also dream; but whether the oviparous dream is uncer-

tain; although it is plain that they sleep, as do the aquatic animals, fishes, mollusca, testacea, and crustacea. A transition is then made to the subject of sex, for the purpose of showing that in the mollusca, crustacea, testacea, and eels, there is no difference in that respect between individuals of the same species.

The subjects of generation and parturition occupy the fifth, sixth, and seventh books. From the comparatively large space which he has devoted to the result of his inquiries in these departments, the minuteness with which he describes the phenomena presented by them in man and the domestic animals, and the accurate knowledge which he frequently exhibits, it may be inferred that they were favourite subjects with Aristotle. It is sufficient for our purpose to mention some of the cases in which he attained the truth, and others in which he failed.

He describes the membranes with which some of the mollusca envelope their eggs, mentions the changes through which insects pass before they acquire the perfect state, and speaks with tolerable accuracy of the economy of bees and wasps. He states, however, that the former make wax from flowers, but gather their honey from a substance which falls from the air upon trees. The eggs of tortoises, he says, are hard, like those of birds, and are deposited in the ground. His remarks on those of lizards and the crocodile are also correct. He states accurately that some serpents bring forth their young enclosed in a soft membrane, which they afterwards burst; but that sometimes the little animals escape from the egg internally, and are produced free. Other serpents, he observes, bring forth eggs cohering in the

form of a necklace. On the eggs of birds his observations are nearly as correct as those which we find in books at the present day. He was acquainted with their general structure, and the development of the chick, which he minutely describes. He remarks of the cuckoo, that it is not a changed hawk, as some have asserted; that, although certain persons have alleged that its young have never been seen, it yet certainly has young; that, however, it does not construct a nest, but deposites its eggs in the nest of other birds, after eating those which it finds there.

He remarks that the cartilaginous fishes are viviparous, but that the other species bring forth eggs, and states correctly that they have no alantoid membrane. He then passes to the cetacea, with which he seems to be nearly as well acquainted as modern naturalists, and reverts to the oviparous fishes, respecting which he presents numerous details. He maintains, however, that the eel is produced spontaneously, and that no person had ever detected eggs or milt in it.

Having discussed the subject of generation, he proceeds, in the eighth book, to treat of the food and actions of animals, their migrations, and other circumstances. The ninth consists of a multitude of topics without any direct relation to each other, but apparently treated as they had successively presented themselves to the author. Thus, at the commencement we find remarks on the peculiarities of disposition observed in the males and females of different animals, the combats of hostile species, the actions of animals, nidification, generation, and other matters. Several species of different classes

are then described, such as the kingfisher, the blackbird, the cuckoo, the marten, eagles, owls, fishes, insects, and quadrupeds.

The fragments which remain of Aristotle's History of Animals may, perhaps, be considered as presenting the general views which he had intended to precede his more particular descriptions; but, regarded even in this light, it cannot be denied that they are extremely deficient in method. There is in them no approach to a regular classification, we do not say of animals, but of subjects to be discussed. He is continually making abrupt transitions, seems to lose sight of the object more immediately in view, to indulge in digressions foreign to it, and frequently repeats a circumstance which he had related before: His work resembles the rude notes which an author makes previous to the final arrangement of his book; and such it may possibly have been. Of descriptions, properly so called, there are few,—those of the elephant, the camel, the bonasus, the crocodile, the chameleon, the cuckoo, the cuttlefish, and a few others, being all that we find.

It may appear strange, that the statements of naturalists should so frequently prove incorrect. In how many works, even of the present day, are errors to be discovered, which might have been avoided by a proper use of the organs of vision, and a resolution to take nothing on trust! But it is much easier to employ the imperfect remarks of others, to collect from books, compare and arrange, than to seek or make opportunities of observation for one's self; and of so little consequence do some men hold the actual inspection of natural objects, that,

without practising it to any extent, they nevertheless arrogate to themselves the title of philosophical inquirers.

In fine, the observations of Aristotle, considering the period at which he lived, and the proneness of the human intellect to wander from the true path, are remarkable for the great proportion of truth which they present to us. Whatever may be their actual merits, they are certainly superior to those of any other naturalist whose works have come down to us from the remote ages of classical antiquity; and we may take leave of this distinguished man by observing, in the words of Dr Barclay, that, "notwithstanding his many imperfections, he did much both for anatomy and natural history, and more, perhaps, than any other of the human species, excepting such as a Haller or Linnæus, could have accomplished in similar circumstances."

The best edition of his History of Animals (Περὶ Ζωων Ἱστορια), is that of Schneider, in 4 vols 8vo, which issued from the press at Leipsic in 1811. Many editions of his works have been published; but the most complete is said to be Sylburge's, printed at Frankfort, containing,—Organon, 1585; Rhetorica et Poetica, 1584; Ethica ad Nicomachum, 1584; Ethica Magna, &c. 1584; Politica et Œconomica, 1587; Animalium Historia, 1587; De Animalium Partibus, &c. 1585; Physicæ Auscultationis, lib. viii. et Alia Opera, 1596; De Cœlo, lib. iv.; De Generatione et Conceptione; De Meteoris, lib. iv.; De Mundo; De Anima; Parva Naturalia; Varia Opuscula, 1587; Alexandri et Cassii Problemata, 1585; Aristotelis et Theophrasti Metaphysica, 1585.

PLINY THE ELDER.

Account of his Life and Works.

Introductory Remarks—Notice respecting Pliny by Suetonius—Account of his Habits, as given by his Nephew, Pliny the Younger—Various Particulars of his Life—His Death occasioned by an Eruption of Vesuvius—Buffon's Opinion of the Writings of Pliny—Judgment of Cuvier on the same Subject—Brief Account of the Historia Naturalis, including Extracts respecting the Wolf, the Lion, and other Animals—Cleopatra's Pearls—History of a Raven—Domestic Fowls—General Remarks.

BETWEEN the death of Aristotle and the birth of the celebrated naturalist whose life and writings we now proceed to delineate, there elapsed nearly three centuries and a half. It was in the reign of Tiberius, in the 774th year of Rome and the 20th of the Christian era, that Pliny was born. Some assert that he was a native of Verona; others maintain that Comum was his birthplace; while Hardouin labours to prove that the honour belongs to Rome. Of his history little, except the circumstances of his death, is known that could afford any interest to those who look into biographies for marvellous adventures, although it would appear that he had travelled extensively, having visited Germany, Spain, the coast of Africa, and perhaps Britain, Egypt, and Judea. There are only two brief notices respecting him to be found among the ancient writers, besides those contained in the works of his nephew,

Pliny the Younger, and the incidental remarks that occur in his own books on natural history. From these, together with a few casual observations by other authors, have been elaborated all the lives of this illustrious naturalist that are to be found in our dictionaries and cyclopædias. The first authentic account is contained in the book of Suetonius, De Viris Illustribus, and is to the following effect:—

Caius Plinius Secundus was a native of New Comum. When young he served with distinction in the cavalry. He was intrusted with the most important procuratorships, and on all occasions discharged his office with the greatest integrity. At the same time he engaged with so much assiduity in the study of literature, that hardly any one, though entirely free from public occupations, wrote so many works. Among these was an account of all the wars that had been carried on between his countrymen and the Germans, which he comprehended in twenty volumes. He also compiled thirty-six volumes of natural history.

From his nephew we learn the following interesting particulars respecting his habits:—In summer he usually began his studies about sunset, and in winter generally at one in the morning, never later than two, bestowing very little time on sleep. Before it was day he went to the Emperor Vespasian, who, like himself, was in the practice of using the hours of darkness for philosophy or business. He then proceeded to discharge the duties of his office, and, on returning home, spent the remainder of the morning in reading or contemplation. In summer, when he happened to have any leisure, he often lay in the sunshine, having a book

read to him, from which he carefully took notes. It was a saying of his, that no treatise was so meagre but that some part of it might afford instruction. Afterwards he usually took a cold-bath, ate a little, and slept a very short time. He then resumed his labours till the hour of dinner. These were his ordinary habits while occupied with his public duties, and amid the tumult of the city. In retirement his studies were still more constant. When travelling, he seemed to set all other cares aside, and employ himself in literary occupations. He had a secretary by his side with a book and tablets, his hands in winter protected by gloves, so that even the inclemency of the weather should not cause any loss of time. For the same reason, when at Rome, he was carried in a sedan chair. By this continued application he accumulated an almost incredible mass of materials, insomuch that his works, had they been preserved, would have formed a library of themselves.

But it is very obvious that the study of books, to which alone he seems to have been addicted, cannot impart all the information necessary to constitute a naturalist; and accordingly the writings of Pliny contain less a description of the objects of which they treat than a compilation of all that had been recorded by observers regarding them. As such, however, they are of considerable value.

At an early age he went to Rome, where he studied under Appion. It does not appear that he could have seen Tiberius, who by this time had retired to Capreæ; but it is probable that he was admitted to the court of Caligula. When twenty-two years of age, he resided some time on the coast of Africa, and afterwards served in the cavalry under Lucius

Pomponius, when he had an opportunity of traversing Germany from one extremity to the other. At this time he wrote a treatise, De Jaculatione Equestri, on the art of casting the javelin on horseback; and afterwards composed an historical work, in which he detailed all the wars carried on by the Romans beyond the Rhine. Returning to Rome at the age of thirty, he pled several causes, and became a member of the college of augurs. Part of his time was spent at Comum in superintending the education of his nephew, for whom, it is probable, he composed his three books entitled Studiosus, in which he described the progress of an orator in the various steps towards perfection. During the greater part of the reign of Nero he seems to have been without any public employment; but towards the end of it he was appointed procurator in Spain, where, it is presumed, he remained pending the civil wars of Galba, Otho, and Vitellius. On revisiting the capital he was favourably received by Vespasian, on whom he had the privilege of waiting every morning before sunrise, as already mentioned. It is probable that at this period he wrote the History of his own Times, which consisted of thirty-one books, and completed the work which Aufidius Bassus had left unfinished. His Natural History, which he dedicated to Titus, appears to have been finished about the 78th year of our era.

He was at Misenum, where he commanded the fleet which protected all that part of the Mediterranean comprised between Italy, the Gauls, Spain, and Africa, when a great eruption of Vesuvius took place. His sister and her son, the latter of whom was then about eighteen years of age, were with him.

He had just retired to his study, when he was apprized of the appearance of a cloud of the most extraordinary form and size. It resembled a pine-tree, having an excessively elongated trunk, from which some branches shot forth at the top, and appeared sometimes white, sometimes dark and spotted, according as the smoke was more or less mixed with earth and cinders. Anxious to discover the cause of this singular appearance, he ordered a light vessel to be got ready, and was proceeding on board, when he met the mariners belonging to the galleys stationed at Retina, who had just escaped from the danger. They conjured him not to advance and expose his life to imminent peril; but he ordered the fleet immediately to put to sea, for the purpose of rendering aid to such as might require it; and so devoid of fear was he, that he noted all the variations and forms which the cloud assumed. By this time the vessels were covered with ashes, which every moment became hotter and more dense, while fragments of white pumice and stones blackened and split with the heat threatened the lives of the men. They were likewise in great danger of being left aground by a sudden retreat of the sea. He stopped for a moment to consider whether he should return; but to the pilot who urged to this expedient, he replied, "Fortune helps the brave —steer to Pomponianus." That officer was at Stabiæ, and being in sight of the danger, which, although still distant, seemed always coming nearer, had put his baggage on board, and was waiting a more favourable wind to carry him out. Pliny finding him alarmed, endeavoured to recall his firmness. In the mean time the flames were burst-

ing from Vesuvius in many places, so as to illuminate the night with their dazzling glare. He consulted with his friends whether it were better to remain in the house or to flee to the open fields; for the buildings were shaken by frequent and violent shocks, so as to reel backwards and forwards, and in the open air they were not less in danger from the cinders. However, they chose to go forth, as the hazardous alternative, covering their heads with pillows, to protect them from the stones. It was now morning, but the country was enveloped by thick darkness. He proceeded towards the shore by the light of torches, but the sea was still so much agitated that he could not embark; and, seating himself on a sail which was spread for him, he asked for some water, of which he drank a little. The approach of flames, preceded by the smell of sulphur, put his companions to flight, excepting two slaves, who assisted him to rise, when he seems to have immediately fallen, suffocated by the vapours and ashes. On the following day, his body was found in the same place without marks of external violence, and resembling a person asleep rather than one who had suffered death. This event took place on the 24th August, in the seventy-ninth year of the Christian era, and a few months after the demise of Vespasian.

As in the case of almost every writer of eminence, so in that of Pliny, we find panegyrists, whose admiration leads them to lavish the most extravagant praise, and calumniators, who seem resolved to leave nothing to be admired. It is astonishing, says one, that in every department he is equally great. Elevation of ideas, and grandeur of style, give additional exaltation to his profound erudi-

tion. Not only was he acquainted with all that was known in his time, but he possessed that facility of forming comprehensive conceptions, which multiplies science; he possessed that delicacy of reflection on which depend elegance and taste; and he communicates to his readers a certain freedom of mind, a boldness of thought, which is the germ of philosophy. His work, which is as varied as Nature, paints her always in a favourable light. It may be said to be a compilation of all that had previously been written, a copy of every thing useful and excellent that existed; but in this copy the execution is so bold,—in this compilation the materials are disposed in a manner so new, that it is preferable to the greater part of the originals which treat of the same topics.*

The judgment of a recent author, founded also on an extensive view of his character, is perhaps more worthy of our confidence. It were impossible, it is remarked, that in handling, even in the briefest manner, so prodigious a number of subjects, he should not have made known a multitude of facts, which are not only in themselves remarkable, but so much the more valuable to us, that he is the only author who has made mention of them. Unfortunately, the manner in which he has collected and expounded them detracts much from their value; while, from the mixture of truth and falsehood, but more especially from the difficulty, and even in some cases the impossibility, of making out the objects of which he speaks, the reader is often left in the dark. Pliny was not such an observer as Aristotle; much less was he a man of genius

* Buffon, Histoire Naturelle, tome i. p. 54, edit. 1785.

like that great philosopher, capable of apprehending the laws and relations according to which Nature has disposed her productions. He was in general merely a compiler, and even in many instances a compiler who, not having himself any knowledge of the objects concerning which he collected the testimony of others, was unable to appreciate the truth of these testimonies, or even in all cases to comprehend their precise meaning. He is in short an author destitute of critical acumen, who, after occupying a great deal of time in making his extracts and arranging them in certain chapters, has added to them reflections which have no relation to science properly so called, but present alternately the most superstitious impressions, or the declamations of a peevish philosophy, which is continually accusing man, nature, and the gods themselves. The facts which he accumulates ought not, therefore, to be considered in connexion with the opinion which he forms of them; but, on the contrary, ought to be restored in imagination to the writers from whom he has derived them; and the rules of criticism should be applied agreeably to what we know of those writers, and the circumstances in which they were placed. Studied in this manner, the Natural History of Pliny is one of the richest stores; it being, according to his own statement, composed of extracts from more than 2000 volumes, written by authors of all kinds, travellers, historians, geographers, philosophers, and physicians,—authors of whom there remain to us only about forty, and of several of whom we have merely fragments, or works different from those which Pliny used; and, even of those whose labours are lost to us, there are many whose names have escaped

from oblivion only through the quotations which he has made from them.

On comparing his extracts with such originals as we still have, and in particular with Aristotle, we find that he was by no means accustomed to select the parts that were most important or most correct. In general, he fixes upon the singular or marvellous; upon those circumstances which answer best for the contrasts which he is fond of making, or for the reproaches which he so often prefers against Providence. He certainly does not place the same confidence in all that he relates; but his doubts and affirmations are made at random, and the most childish stories are not those that most excite his incredulity. For example, there are none of the fables of the Grecian travellers, about headless and mouthless men, men with only one foot, or men with large ears, that he does not place in his seventh book, and with so much confidence in their truth, that he concludes his enumeration with this remark: *Hæc atque talia ex hominum genere, ludibria sibi, nobis miracula, ingeniosa fecit natura:* "See how nature is disposed for the nones to devise full wittily in this and such like pastimes to play with mankind, thereby not onely to make herselfe merrie, but to set us a wondering at such strange miracles." Any one may judge, from this credulity in respect to the absurd fables about the human species, of the little discernment which he must have exercised in selecting testimonies respecting exotic or little-known animals. Accordingly, the most fabulous creatures, manticores, with the head of a man and the tail of a scorpion, winged horses, catoblepas, the mere sight of which caused death, oc-

cupy their station by the side of the elephant and lion. However, all is not false even in those articles which are most replete with falsehoods. We can sometimes come at the truths which have given rise to them, by recollecting that they are extracts from travellers, and supposing that the ignorance of the ancient tourists, and their love of the marvellous, betrayed them into the same exaggerations, and dictated the same vague and superficial descriptions, with which we are shocked in so many of their modern successors. It may likewise be said of Pliny, that he does not always give the true sense of the authors whom he translates, especially when treating of the designation of species. Although we have now very few means of judging with certainty respecting errors of this kind, it is easy to prove, that on several occasions he has substituted for the Greek word which denoted a particular animal in Aristotle, a Latin word which belongs to another species. It is true that one of the great difficulties experienced by the ancients was that of fixing a nomenclature; and the defects of their systems are more perceptible in Pliny than in any other writer. The descriptions, or rather the imperfect indications, which he gives, are almost always insufficient for recognising the species, when tradition has not preserved the names; and there is even a very great number, of which he mentions the names without joining to them any character, or affording any means by which they may be distinguished. Could there be any longer a doubt as to the advantages of the systems invented by the moderns, it would be dissipated by finding that all that the ancients have said of the virtues of their plants is lost to us, from

our not being able to distinguish the species to which they assigned them.—Were we to give credit to all that he says in the part of his work devoted to Materia Medica, there is not a disease incident to humanity for which nature has not provided twenty remedies; and unfortunately, during two centuries after the revival of letters, all these absurdities were confidently repeated by physicians. It must therefore be admitted, that with reference to facts the volume of Pliny is of no real interest, excepting in regard to the manners and customs of the ancients, the processes which they followed in the arts, and some particulars respecting geography, of which we should otherwise be ignorant.*

The Historia Naturalis was the last work which Pliny wrote, and is the only one that has come down to us. It is not a treatise on natural history, as that term is at present limited; but, besides relating all that he knew of animals, plants, and minerals, it embraces astronomy, geography, agriculture, commerce, medicine, and the arts; so that it may be considered as a cyclopædia rather than a publication on any particular subject. It is divided into thirty-seven books.

The first contains a dedication to the Emperor Titus Vespasian, together with a summary of the following sections, and the names of the authors who contributed to them.

In the second book, he treats of the universe, the elements, and the stars. The world and the heavens, which he says are God, are infinite, without beginning and without end; the form of the latter is spherical, the motion circular, and they are impressed with

* See Life of Pliny, by Cuvier, in the Biographie Universelle, tome xxxv. p. 70.

innumerable forms of animals and other objects. The elements are four; namely, fire, air, earth, and water. There are seven planets, or wandering stars, in the midst of which moves the sun, the ruler of all things. As to God, if indeed there be any Existence distinct from the world, it were absurd, says he, to assign him any form or image, He being all in all; for which reason the gods that the nations worship are mere fancies. It is absurd to imagine that He should have regard to the human race, for by interfering with their affairs he would necessarily be polluted. Men, he observes, are wretchedly prone to superstition of all kinds; however, it is beneficial, he admits, to believe that the gods take care of them, and punish malefactors. The nature of the planets, the moon, eclipses, comets, lightning, winds, clouds, meteoric stones, land, water, earthquakes, and many other subjects, are discussed in this book.

The third, fourth, fifth, and sixth, treat of geography; and the seventh of the different races of men, monsters, great characters, human inventions, longevity, and other matters relating to the human race, disposed without order, and selected without discrimination.

The eighth book, which is devoted to land-animals, contains notices respecting the elephant, dragons, serpents, lions, panthers, tigers, the camel, the camelopard, the rhinoceros, and a multitude of other mammalia, and reptiles. As a specimen of our author's manner of discussing these subjects, we give his account of the wolf:—

It is commonly believed, says he, in Italy, that the sight of wolves is hurtful, and that when they see a man before he observes them, they cause him to lose

his voice for the time. Those which are produced in Africa and Egypt are small and sluggish; but in the colder climates they are fierce and cruel. That men are changed into wolves, and afterwards restored to their proper shape, we must either believe to be false, or else at once admit all those tales which have for so many ages been proved to be fabulous. But how this opinion came to be so firmly fixed, that when we would apply the most opprobrious term to one, we call him *versipellis* (or turnskin), I shall shew. Euanthes, a respectable Greek writer, reports that he found among the records of the Arcadians, that a person is chosen by lot from the family of Anthus. Being led to a certain pool in that country, he relinquishes his clothes, which are hung up on an oak, swims over, proceeds into the deserts, is transformed into a wolf, and for nine years herds with the wild animals of that race. This period being completed, if he has refrained from eating human flesh, he returns to the same pool, and, recrossing it, is restored to his original form, only looking nine years older than before. Fabius adds, that he finds his clothes again. It is strange to see how far the credulity of the Greeks goes; for there is no lie so shameless that it does not find one of them to vouch for it. Thus, Agriopas, who wrote of the conquerors at the Olympic games, relates that Demœnetus of Parrhasia, at a sacrifice, ate of the entrails of a child that had been offered as a victim (for the Arcadians at that time offered human sacrifices to Lycean Jupiter), and turned himself into a wolf; and that the same person, ten years after, having been restored to his proper shape, fought at the Olympian games, and was proclaimed victor. Besides, it is commonly

believed that in the tail of this animal there is a minute hair possessing a power over love, and that the wolf casts it when he is taken; but that it has no efficacy unless it be plucked from him when alive. Wolves pair only during twelve days in the whole year. When famished, they eat earth. With respect to auguries, when one meets a wolf, and the latter turns to the right hand, especially if he have a full mouth, there could not be a better presage. There are some of this kind that are called stag-wolves, such as the one mentioned by us as having been seen in the circus of Pompey the Great. They say that this animal, however hungry he may be, should he happen to look back, forgets the food which he had, and goes to look for some elsewhere.

The following extract from Pliny's account of the lion, "right pleasaunte" as it is in the original, is rendered still more so by Dr Holland. "To come againe to our lions: the signe of their intent and disposition, is their taile; like as in horses, their ears: for these two marks and tokens, certainly hath nature given to the most couragious beasts of all others, to know their affections by: for when the lion stirreth not his taile, hee is in a good mood, gentle, mild, pleasantly disposed, and as if hee were willing to be plaied withall; but in that fit he is seldome seene: for lightly hee is alwaies angrie. At the first, when hee entreth into his choller, hee beateth the ground with his taile: when hee groweth into greater heats, hé flappeth and jerketh his sides and flanks withall, as it were to quicken himselfe, and stirre up his angry humor. His maine strength lieth in his breast: hee maketh not a wound (whether it be by lash of taile, scratch of claw, or print of

tooth), but the bloud that followeth is blacke. When his belly is once full, all his anger is past, and he doth no more harme. His generositie and magnanimitie he sheweth most in his daungers: which courage of his appeareth not onely herein, that he seemeth to despise all shot of darts against him, defending himselfe a long time onely with the terrible aspect of his countenance, and protesting as it were that he is unwilling to deale unlesse he be forced thereto in his own defence, and at length maketh head againe, not as compelled and driven thereto for any perill that he seeth, but angred at their follie that assaile and set upon him: but herein also is seen rather his noble heart and courage, that be there never so many of hounds and hunters both following after him, so long as hee is in the open plaines where he may be seene, hee maketh semblance as though he contemned both dog and man, dismarching and retiring with honour, and otherwhiles seeming in his retreat to turne againe and make head; but when he hath gained the thickets and woods, and gotten once into the forrests out of sight, then he skuds away, then hee runneth amaine for life, as knowing full well that the trees and bushes hide him, that his shamefull dislodging and flight is not then espied. When he chaseth and followeth after other beasts, hee goeth alwaies saltant or rampant; which he never useth to doe when he is chased in sight, but is onely passant. If hee chaunce to be wounded, hee hath a marveilous eye to marke the partie that did it, and be the hunters never so many in number, upon him he runneth onely. As for him that hath let flie a dart at him, and yet missed his marke and done no

hurt, if he chaunce to catch him, hee all to touzeth, shaketh, tosseth, and turneth him lying along at his feet, but doth him no harme at all besides. When the lionesse fighteth for her young whelpes, by report, she setteth her eies wistly and entirely upon the ground, because she would not be affrighted at the sight of the chasing-staves of the hunters. Lions are nothing at all craftie and fraudulent, neither be they suspicious: they never look askew, but alwaies cast their eie directly forward, and they love not that any man should in that sort looke side-long upon them. It is constantly beleeved, that when they lie a dying they bite the earth, and in their very death shed teares. This creature, so noble as he is, and withall so cruell and fell, trembleth and quaketh to heare the noise of cartwheeles, or to see them turne about; nay he cannot abide of all things charriots when they be void and emptie: frighted he is with the cocks comb, and his crowing much more, but most of all with the sight of fire. The lion is never sick but of the peevishnes of his stomacke, loathing all meat: and then the way to cure him, is to tie unto him certain shee apes, which with their wanton mocking and making mowes at him, may move his patience and drive him for the verie indignitie of their malapert saucinesse, into a fit of madnesse; and then, so soone as he hath tasted their blood, he is perfectly well againe: and this is the onely remedie.

"*Q. Scævola* the sonne of Publius, was the first at Rome that in his Curule Ædileship exhibited a fight and combat of many lions togither, for to shew the people pastime and pleasure: but *L. Sylla*, who afterwards was Dictatour, was the first of all others that in

his Pretorship represented a shew of an hundred lions, with manes and collars of haire: and after him *Pompeius* the Great shewed 600 of them fighting in the grand Cirque, whereof 315 were male lions with mane. And *Cæsar* Dictatour brought 400 of them into the shew-place. The taking of them in old time was a verie hard peece of worke, and that was commonly in pit-fals: but in the Emperor *Claudius* his daies it chaunced, that a shepheard or heardman who came out of Gætulia, taught the manner of catching them: a thing (otherwise) that would have been thought incredible, and altogither unbeseeming the name and honour of so goodly a beast. This Getulian I say, fortuned to encounter a lion, and when he was violently assailed by him, made no more adoe but threw his mandilion or cassocke full upon his eies. This feat or cast of his was soone after practised in the open shew-place, in such sort, that a man would hardly have beleeved, but he that saw it, that so furious a beast should so easily be quailed and daunted so soone as ever hee felt his head covered, were the things never so light; making no resistance, but suffering one to doe what he would with him, even to bind him fast, as if in very truth all his vigor and spirit rested in his eyes. Lesse therefore is it to be marveiled at, that *Lysimachus* strangled a lion, when as by commaundement of *Alexander* the Great, he was shut up alone togither with him. The first that yoked them at Rome and made them to draw in a charriot, was *M. Antonius.* And verily it was in the time of civill warre, after the battaile fought in the plains of Pharsalia, a shrewd fore-token and unhappie presage for the future event, and namely, for men of

an high spirit and brave mind in those daies, unto whom this prodigious sight did prognosticate the yoke of subjection: for what should I say, how Antonie rode in that wise with the courtisan *Cytheris*, a common actresse in enterludes upon the stage? to see such a sight was a monstrous spectacle, that passed all the calamities of those times. It is reported, that *Hanno* (one of the noblest Carthaginians that ever were) was the first man that durst handle a lion with his bare hand, and shewe him gentle and tame, to follow him all the citie over in a slip like a dogge. But this device and tricke of his turned him to great domage, and cost him his utter undoing: for the Carthaginians hereupon laid this ground, that *Hanno*, a man of such a gift, so wittie and inventive of all devises, would be able to persuade the people to whatsoever his mind stood; and that it was a daungerous and ticklish point to put the libertie of so great a state as Carthage was, into the hands and managing of him, who could handle and tame the furious violence of so savage a beast: and thereupon condemned and banished him." He then relates two examples of the gentleness of this animal, or rather of his confidence in man. On one occasion, a lion applied to Mentor, a Syracusan, for relief from a thorn which had pierced his foot; and on another, Elpis, a Samian, had the honour, when in Africa, of extracting a bone from the palate of the royal beast, for which he was rewarded by him with an abundant supply of fresh venison so long as he remained in the country.

In this book Pliny follows no methodical arrangement, either as to the animals themselves or as to the descriptions and anecdotes in each article. He

commences indeed with the largest, and ends with mice, which are among the smallest bred on land; but in this catalogue he includes mammalia, crocodiles, lizards, serpents, and snails. It may be said generally, that in his descriptions at least three-fourths of each article are erroneous, false, or fabulous; and that he scarcely anywhere attempts to elicit general principles, or to discover the circumstances in which animals agree or differ. It were therefore vain for the student of nature to look into this book for any information on which he could place reliance, with respect to their organization or habits. Some particulars respecting the exhibition at Rome of elephants, lions, panthers, crocodiles, and other ferocious creatures, with the combats of which the emperors and great men amused the people, and a few facts relating to the geographical distribution of the more interesting species, are all that the reader finds to recompense him for the labour of examination.

The ninth book treats of fishes, crabs, sea-urchins, mollusca, and other marine animals, including not only turtles and cetacea, but also mermaids, tritons, and other fabulous creatures. These he arranges in no definite order, although he proposes a kind of classification founded on the covering or skin; some, as seals and hippopotami, having a skin and hair; others skin only, as the dolphin; while the tortoises are covered with a substance resembling bark; oysters and other shells with a substance as hard as flint; echini with crusts and prickles; fishes with scales; sharks with a rough skin fit for polishing wood; lampreys with a soft skin; and polypi with none at all.

As might be expected, many wonderful tales are related of the dolphin, which was a special favourite with the ancients, on account of its supposed attachment to the human species. One of these animals, if we may credit Pliny and his authorities, carried a boy daily to school and home again, from Baianum to Puteoli; another, who used to mount a child on his back, having one day suffered him to be drowned, brought back his body, and out of grief thrust himself ashore, where he of course died; and, lastly, a king of Caria having caught a dolphin, and kept him prisoner within the harbour, a whole multitude of the same species came to beg his release, and remained until their prayer was granted.

The most interesting chapters in this book are those on pearls and the shell-fish that furnished the purple dye so highly esteemed by the Romans. This oyster, he says, which is the mother-of-pearl, at a certain season of the year, gapes and receives one or more drops of a kind of dew, which are ultimately converted into pearls. According to the nature of this dew, or the state of the weather at the time of its being received, the pearl is dusky or white, dull or possessed of a brilliant lustre. These ornaments were very highly esteemed in Pliny's days. The ladies wore them dangling at their fingers and ears, took great delight in hearing them rattle, and not only appended them to their upper garments, but even embroidered their buskins with them. It will not suffice them, says he, nor serve their turn, to carry pearls about them, but they must tread upon pearls, go among pearls, and walk as it were on a pavement of pearls. Lollia Paulina, the wife of Caligula, was seen by him,

on an ordinary occasion, ornamented with emeralds and pearls, which she valued at forty millions of sestertii (about £300,000).

The two finest specimens ever seen were in the possession of the celebrated Cleopatra, who, on being sumptuously feasted by Mark Antony, derided him for the meanness of his entertainment; and on his demanding how she could go beyond him in such a matter, answered that she would spend upon him in one supper ten millions of sestertii. Antony, conceiving it impossible for her to make good her boast, laid a great wager with her about it. When the supper came, although it was such as to befit the condition of the hostess and guests, it presented no extraordinary appearance; so that Antony jeered the queen on the subject, asking by way of mockery a sight of the bill of fare; whereupon she affirmed, that what had as yet been brought to table was not to be reckoned in the count, but that even her own part of the supper should cost sixty millions. She then ordered the second service to be brought in. The servants placed before her a cruet of vinegar, and she put into it one of the pearls which were appended to her ears. When it was dissolved, she took up the vessel, and drank its contents; on which Lucius Plancus declared that she had gained the wager. Afterwards, when Cleopatra was taken prisoner and deprived of her royal estate, the other pearl was cut into two, and affixed to the ears of the statue of Venus in the Pantheon at Rome.

The tenth book speaks of birds, beginning with the larger species, and concluding with remarks on generation, the food of animals, and other circum-

stances of a general nature. He believes that the spinal marrow of a man, as many persons have asserted, may turn into a snake; that salamanders, eels, and oysters, are neither male nor female; and that young vipers make their way through the sides of their mother. His History of Birds is extremely meagre and incorrect; but many amusing particulars are related by him, of which we select two examples.

In the days of Tiberius Cæsar, a young raven that had been hatched in a nest upon the temple of Castor and Pollux took her first flight into a shoemaker's shop just opposite. The master of the booth was well pleased to receive the guest, especially as it had come from so sacred a place, and took great care of it. In a short time the winged visiter began to speak, and every morning flew to the top of the rostra, where, turning to the open forum, he saluted the emperor, and after him Germanicus and Drusus, the young princes, each by his name, and after them the people that passed by. This he continued to do for many years, till another shoemaker, either envying his neighbour the possession of so rare a prize, or enraged at the bird for muting on his shoes, killed him. At this rash proceeding, the people were so indignant that they drove the ungenerous mechanic out of the street, and afterwards murdered him. The body of the raven was solemnly interred in a field two miles from the city, to which it was carried by two blacks, with musicians playing before, and a great crowd following. In such esteem, says Pliny, did the people of Rome hold this wit and aptness to learn in a bird, that they thought it a sufficient cause for ordering a sumptuous funeral, and even for putting a man to death,

in that very city where many brave and noble persons have died without having their obsequies solemnized, and which afforded not one individual to revenge the undeserved death of the renowned Scipio Æmilianus, after he had conquered both Carthage and Numantia.

Cocks, he says, which are our sentinels by night, and destined by nature to rouse us from sleep and call us up to our work, have also, like the peacock, a sense of glory, and a love of approbation. They are astronomers too, and know the course of the stars; they divide the day by their crowing, which is performed at the end of every three hours; they go to roost when the sun sets, and before he rises again they warn us of the approach of day by clapping their wings and crowing. They are rulers in their own community, whether consisting of other males or females. Their sovereignty is obtained by combat, as if they knew that they had weapons on their heels for the purpose, and the battle is often protracted until one is killed. The conqueror proclaims his victory by crowing, while the vanquished hides his head in silence, although it goes hard with him to be beaten. Not only are these fighting cocks thus high-minded, but even the common dunghill kind are equally proud, marching in a stately manner, their neck erect, with a comb on the head like the crest of a soldier's helmet. There is no other bird that so often looks aloft to the sun and sky, and as he moves he carries his tail in an arched form. Even the lion, the most courageous of animals, stands in awe of the cock. Some of these birds are made for nothing else than fighting, and are never satisfied unless when engaged in a quarrel; and to them the emperors

and nobles of Rome do not disdain to give honour. The best breeds are from Rhodes, Tenagra, Melos, and Chalcis. These birds rule our rulers, nor is there a great man in Rome that dare open or shut the door of his house before he knows their good pleasure; even the sovereign, in all the majesty of the empire, with the insignia of office, neither sets forward nor recedes without their direction. They give orders to armies to advance to battle, or command them to keep within the camp. They supplied the signal and foretold the issue of all the famous fields, in which the Romans achieved their victories in all parts of the world. In a word, they command the greatest commanders of all nations, and, small as they are, prove as acceptable to the gods in sacrifice as the largest and fattest oxen. Their crowing out of time is portentous, and it is well known that, by once crowing all night long, they foretold to the Bœotians the noble victory which that people achieved over the Lacedemonians, for this result was expected, as these birds never crow when beaten. When converted into capons, they cease to crow; but in this state they become sooner fat. At Pergamus there is a solemn cock-fight every year. It is recorded that, within the territory of Ariminum, in the year when Marcus Lepidus and Quintus Catulus were consuls, a dunghill-cock, belonging to one Galerius, spoke; but, as far as Pliny could learn, the like never happened again.

Bees, silkworms, spiders, scorpions, locusts, grasshoppers and a few other animals of a similar nature, are briefly treated of in the eleventh book, which, moreover, contains an anatomical description of the human body, and of various parts of animals, not

remarkable for its accuracy, but not the less interesting to the historian of science. The greater part is derived from Aristotle.

Then follow seventeen books on plants, their cultivation and uses in domestic economy and the arts, and the remedies that are obtained from them. These subjects form the most extensive portion of Pliny's writings, but they are discussed in so irregular and injudicious a manner, that it is impossible, in most cases, to determine the species of which he speaks; and as to the cures alleged to be accomplished by means of herbs, it is obvious that no confidence can be placed in his details. The culture of many of the more important species, such as the vine, the mulberry, the olive, wheat, and other cereal plants, is described at length; as are the processes of making bread, wine, olive-oil, and other substances obtained from vegetables.

The twenty-eighth book treats of dietetics, remedies derived from various animals, and the nature and cure of certain diseases. These subjects are continued to the end of the thirty-second book, and give occasion to the discussion of numerous topics, such as water, magic, medicine, &c.

The metals are considered in the two next books; colours and painting in the thirty-fifth; stones and minerals are mingled in the thirty-sixth with obelisks, temples, and statues; and the last book contains an account of precious stones, the descriptions of some of which, amber and beryl, for example, are as good as those of many of our modern mineralogists.

It is not our object to present a detailed account of the contents of any of these books, it being suffi-

cient for our purpose to indicate the general nature of the work, and to point out a few of the subjects discussed. It affords a magazine of curious information on most subjects connected with natural history and the arts; but it is obvious that this information could not be useful to the student unless he were furnished with a correct commentary. Pliny's volumes have been translated into various modern languages, and there is an English version by Dr Philemon Holland, published at London in 1601. This performance, although generally accurate, fails in the nomenclature of the plants and animals; so that a good translation is a desideratum at the present day, which, however, is not likely to be soon supplied,—an extensive acquaintance with Greek and Roman literature, and a critical knowledge of the various branches of natural history, being essentially requisite in him who should undertake it.

Although Pliny cannot be depended upon as a naturalist, his writings are important as a source of pure Latinity. His style is generally simple, sometimes harsh, usually laconic, although when he enters upon philosophical reflections it becomes animated, energetic, and copious. His morality is more pure than we could have expected, considering his doubts respecting the existence of a Deity, his disbelief in the immortality of the human soul, and the absence of those motives by which mankind are commonly influenced. He never ceases to censure vice of every kind; and as to the examples of cruelty, luxury, and effeminacy, which he has occasion to relate, his remarks are not less accordant with reason than with the soundest principles of Christian ethics.

The first editions of Pliny appeared at Venice in

1469, and at Rome in 1470. The most useful and convenient is that of Franzius, in ten volumes 8vo, published at Leipsic in 1791.

From what has been said above it will appear, that down to the time of Pliny naturalists had not succeeded in forming any system of zoology. In the writings of that author, the animals of which he treats are so disposed, that the absence of all arrangement is very obvious; nor is it even possible to guess upon what principle he makes the species succeed each other. In his chapter on land-animals, he places the elephant first; and as mice come last, we might imagine that he had intended to proceed on the principle of size. The bison, the wild-horse, the elk, the bonasus, the lion, the panther, the tiger, the camel, and the camelopard, of which the first individual seen at Rome was exhibited by Julius Cæsar at the Circensian games, follow in order. Then come the rhinoceros, the lynx, apes and monkeys, wolves, serpents, the ichneumon, the crocodile, the skink, the hippopotamus, first shown at Rome by Marcus Scaurus, lizards, tortoises, hyenas, frogs and seals, deer, porcupines, bears, marmots, squirrels, vipers, snails, dogs, horses, asses, and mules, and the other principal domestic animals. His arrangement of birds is equally unsystematic. The fabulous phœnix occupies the first rank, and is followed by eagles, hawks, birds of evil omen, as ravens and owls, woodpeckers, peacocks, the domestic fowl, geese, cranes, swans, thrushes, doves, the ibis, the nightingale, and the kingfisher. With these are mingled various heterogeneous elements. The same may be said of all the other departments. Were the knowledge of animals which we

possess at the present day not regularly methodized, it would be utterly impossible for an individual to distinguish half the number of mammalia and birds, which are among the least extensive classes. The first inventor of a system, however imperfect, has therefore the strongest claims upon our gratitude. Aristotle may be said to have laid the foundation for one, or at least to have made an attempt; Ray was the first who sketched a rude classification, in which he partly adopted that of the Stagirite: it is to Linnæus, however, that we owe a system, which is at least methodical and perspicuous; and if succeeding zoologists have produced more perfect arrangements, they can only be said to have improved upon his.

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GESNER,
BELON, SALVIANI, RONDELET;
AND ALDROVANDI.

Zoologists of the Sixteenth Century.

Conrad Gesner—Account of his Life and Writings, preceded by Remarks on those of Ælian, Oppian, Albertus Magnus, Paolo Giovio, and Hieronymus Bock—Pierre Belon—Hippolito Salviani—Guillaume Rondelet—Ulysses Aldrovandi—General Remarks on their Writings, and the State of Science at the Close of the Sixteenth Century.

CONRAD GESNER.

From the time of Pliny to the commencement of the sixteenth century, zoology, like the other sciences, made little progress. The only naturalists during the earlier portion of this interval at all deserving of notice are Ælian and Oppian. The former was born at Prænestе in the year 160, and wrote in Greek a History of Animals, which, like that of the philosopher of Comum, is disfigured by numerous errors and fables. The latter was a poet, a native of Cilicia, who lived under the Emperor Caracalla in the beginning of the third century. Two only of his productions are now extant, his Halieuticon and Cynægeticon; the one containing five books on fishing, the other, four on hunting. These works are still occasionally consulted, though they afford little useful information, and might without any loss to science be consigned to oblivion.

The principal author who appeared between the epoch which witnessed the destruction of the Roman Empire and the beginning of the century just specified, was Albertus Magnus; so called, according to some, not because he was great as a man of science, but because his family-name was Groot, which in Dutch signifies "great," and being Latinized, as was then the fashion, became "magnus." However, he was not a small personage in his day; for it is told of him that he constructed a brazen head which had the faculty of answering questions, and wrote so many works that, when collected for a general edition at Lyons in 1651, they filled twenty-one thick folios. His character was highly respectable, and his History of Animals is certainly a remarkable production for the age in which he lived. Born at Lavingen in Suabia in 1205, he received his education at Pavia, where he entered the order of Dominicans. Some time having elapsed, he went to Paris and delivered public lectures with applause. In 1248, he was invited to Rome by Pope Alexander III., who appointed him to the office of Master of the Holy Palace, and bestowed on him the bishopric of Ratisbon, which he soon after resigned. Returning to Cologne, he resumed his lectures, which were much frequented. Pope Gregory X. called him to assist at the general council, held at Lyons in 1274, where the conclave of cardinals for the election of the successor of St Peter was first instituted. He died at Cologne at the age of 77. The celebrated Thomas Aquinas, who was his pupil, is reported to have broken, in a fit of terror, his famous brazen oracle; and the progress of science has shown as little respect to his other works, consisting

chiefly of a commentary on Aristotle, with certain additions from the Arabian writers.

Sir Thomas Browne, in his famous Enquiries into Vulgar and Common Errors, thus characterizes our author:—"Albertus, bishop of Ratisbone, for his great learning and latitude of knowledge sirnamed Magnus, besides divinitie, hath written many Tracts in Philosophie; what we are chiefly to receive with caution, are his naturall Tractates, more especially those of Mineralls, Vegetables, and Animals, which are indeed chiefly Collections out of Aristotle, Ælian, and Plinie, and respectively containe many of our popular errors. He was a man who much advanced these opinions by the authoritie of his name, and delivered most conceits, with strickt enquirie into few."

It is scarcely necessary to mention here a work on the fishes of Rome, De Romanis Piscibus, by the celebrated Paolo Giovio, an Italian writer of this age, who was born at Como in the year 1483. It was dedicated to the Cardinal of Bourbon, and appeared in 1524, but is of little or no value, being the production of a person who, although eminent in general literature, had no claims to the character of a naturalist.

Another author who lived at this period, Hieronymus Bock, generally known by his Latinized name Tragus, was principally distinguished as a botanist, although he wrote also on animals. In 1549, he published a work entitled Kraeuterbuch von den vier Elementen, Thieren, Voegeln, and Fischen, of which there have been various editions. He was born at Heidesbach at Zweybruecken in 1498, and died, in the 56th year of his age, on the 21st of June 1554.

The sixteenth century produced a little band of worthies, who, without having made great acquirements, may yet be justly styled the fathers of modern zoology. These were Guillaume Rondelet, a physician of Montpellier; Hippolito Salviani, also a physician, and a native of Citta di Castello in Umbria; Conrad Gesner, surnamed the German Pliny, who was born at Zurich, and followed the same profession; Pierre Belon, a Frenchman; and Aldrovandi, professor at Bologna. In presenting a sketch of the lives and labours of these venerable sages, we shall begin with him whom Haller characterizes as a prodigy of knowledge, *monstrum eruditionis*.

Conrad Gesner, one of the most celebrated of this class of naturalists, was born at Zurich on the 26th March 1516. His parents were of an humble rank in life, and having several other children, could not have given him the benefit of a good education, had it not been for the kindness of his maternal uncle, a clergyman, who imparted to him the rudiments of knowledge, and instructed him in botany. This relative, however, died while he was yet at an early age; and when not more than fifteen he was also deprived of his father, who was killed at the battle of Zug, in which the celebrated reformer Zuinglius or Zwingle lost his life. The small patrimony left by his parent having been divided among a large family, Gesner was reduced to great distress, which was heightened by a dropsical affection. Recovering from this disease, he resolved to seek his fortune in another country, and going to Strasburg, entered into the service of Wolfgang Fabricius Capito, professor of Hebrew in the university of that city. Soon after, receiving pecuniary assist-

ance from the canons of Zurich, he betook himself to Bourges, where he commenced the study of medicine. At the age of eighteen, he had occasion to go to Paris, where he indulged to excess his literary appetite, and devoured indiscriminately all kinds of knowledge; being supported meanwhile by a young Bernese nobleman, named Steiger, who had contracted a friendship for him. Soon after, he returned to Strasburg, whence, in 1536, he was recalled to Zurich, to teach some children the elements of grammar, with a salary barely sufficient for his support. In the following year, the magistrates, perceiving the superiority of his character, furnished him with an additional grant of money, which enabled him to go to Basil to prosecute his medical studies. To increase his income he assisted Phavorinus in editing his Lexicon, and in a short time removed to Lausanne, where the senate of Berne appointed him Greek professor, in which office he continued three years. He then went to Montpellier, where he engaged more particularly in the study of anatomy and botany, and formed an intimate acquaintance with the celebrated Laurent Joubert and the naturalist Rondelet. In 1541, he obtained the degree of doctor in medicine at Basil, where he arranged some extracts respecting botany and physic, taken from Greek and Arabian writers, which were published the following year at Zurich and Lyons; in the former of which places he now took up his residence and engaged in professional practice. Soon afterwards, he published a catalogue of plants in four languages, in which he evinced his extensive knowledge of botany, which was subsequently increased by several excursions among the Alps. In 1545, he

made a journey to Venice and Augsburg, where he enjoyed some valuable opportunities of consulting rare works and manuscripts. The same year, he commenced the publication of his famous Bibliotheca Universalis, which contains a catalogue of all the works then known, whether extant or lost. Several other fruits of his industry appeared successively between this period and the year 1555, when his merits induced the magistrates of Zurich to appoint him professor of natural history. The Emperor Ferdinand I., to whom he dedicated one of his works, the History of Fishes, rewarded him with various marks of his esteem. These, however, he did not long enjoy, as he fell a victim to a pestilential disease which, commencing at Basil in the spring of 1564, afterwards broke out in his native city with increased violence. When attacked by this fatal malady he betook himself to his cabinet, for the purpose of arranging his papers, and in this occupation died on the 13th December 1565, at the age of 49 years and a few months; leaving a widow who had participated in his adversity and prosperity, having been married by him when he acted as grammar-teacher at Zurich. He bequeathed his library and manuscripts to Caspar Wolf, his pupil, with injunctions to print all that could be rendered fit for the public eye. His principal work is the Historia Naturalis Animalium, chiefly composed of extracts from Aristotle, Ælian, and Pliny, without order or discrimination, but intermixed with numerous original observations, and illustrated by rude engravings. It consists of five books, and forms four folio volumes. There is an English translation by Topsell of part of it under the name of The History of four-footed

Beasts and Serpents, collected out of the Writings of Conradus Gesner. Down to the end of the seventeenth century his compilations were held in the highest estimation in every department of zoology: they are now considered as objects of curiosity rather than stores of useful knowledge.—The three next of whom mention is to be made were chiefly eminent as ichthyologists.

PIERRE BELON.

THE three great authors, it has been remarked, who really laid the foundation of modern ichthyology, appeared in the middle of the sixteenth century, and, what is remarkable, almost at the same time: Belon, in 1553; Rondelet, in 1554 and 1555; Salviani, from 1554 to 1558. Unlike the compilers who, after Aristotle and Theophrastus, swell our list of writers, they saw and examined for themselves the fishes of which they speak, and had drawings of them taken under their immediate inspection with considerable accuracy. Too faithful, however, to the spirit of their time, they took more pains to find out the names which these fishes bore among the ancients, and in selecting fragments for their history, than in describing them in a distinct manner; so that, were it not for the figures, it would in many instances be almost impossible to determine their species.*

Scarcely any of the older naturalists, however, confined their attention to one department of their favourite science. Belon was a physician, a zoologist, and a botanist. He was born at Souletière, in the parish of Oisé, in Le Maine, about the year

* Cuvier, Hist. Nat. des Poissons.

1518. It is supposed that his parents were poor; and we accordingly find that he was indebted for his education to René du Bellay, bishop of Mans, William Duprat, bishop of Clermont, and the Cardinals of Tournon and Lorraine. At an early age, he commenced the study of medicine and botany, and having distinguished himself among the pupils of Valerius Cordus, professor of natural history at Wirtemberg, was allowed to accompany his master on the excursions which he was wont to make into Germany and Bohemia, for the purpose of obtaining specimens. On finishing his education he travelled through Greece, Egypt, Palestine, and Asia Minor, whence he returned to Paris in 1550, with a valuable collection, after an absence of three years. He now arranged the materials which he had thus procured, and published several interesting works; notwithstanding the merit of which, he experienced great difficulty in obtaining admission into the medical faculty of Paris. In 1557, he undertook another journey into Italy, Savoy, Dauphiny, and Auvergne. On his return, he engaged in a translation of Dioscorides and Theophrastus, and was preparing an important work on agriculture, when he was murdered in the wood of Boulogne, as he was proceeding from Paris to his place of residence at the Chateau de Madrid. This happened in 1564, when he was about forty-five years of age.

His first great performance was the Natural History of Sea Fishes, with wood engravings, containing a figure and description of the dolphin, and several other species of the same family. It was published at Paris in 1551, in quarto. In 1553, he gave to the world another work on fishes, entitled De Aquatili-

bus Libri Duo, cum Eiconibus ad Vivam ipsorum Effigiem, which he afterwards translated into French, and with certain additions printed in three different forms in 1555. A work on pines and other evergreen trees, De Arboribus Coniferis, also appeared in 1553, as well as a dissertation on Egyptian antiquities. Soon after he presented to the public his Observations de plusieurs Singularités et Choses memorables, trouvées en Grèce, Asie, Judée, Egypte, Arabie et autres Pays étranges, redigées en trois livres, in which are many curious details on the subject of geography, and on the manners of Eastern nations. A treatise on birds was published at Paris in 1555; another, containing representations of animals and plants observed in Arabia and Egypt, was put forth in 1557; which in 1558 was succeeded by an essay on the cultivation of plants. As a botanist, Belon ranks not less highly than as a zoologist; and, to do honour to him in the former capacity, Plumier has dedicated to his memory an American genus, to which he has given the name of *Belonia*.

HIPPOLITO SALVIANI.

The Aquatilium Animalium Historia of Salviani is chiefly remarkable for the beauty of its engravings, some of which have scarcely been surpassed by the efforts of modern art. The titlepage bears the date of 1554, but the work was not completed till 1558. It contains descriptions of ninety-nine species of fishes, each including the synonymy, the external appearance of the animal, the places in which it occurs, its habits, the manner in which it is caught and prepared, and its medical properties. He also points

out the passages in Aristotle, Pliny, and other ancient writers, who have spoken of them, and to the observations of these authors adds many excellent ones of his own; so that the work, on account of the general accuracy of the plates and descriptions, is one that may be considered indispensable to the modern ichthyologist.

Salviani was born in 1514, at Citta di Castello in Umbria. His family was noble. After finishing his studies, he settled at Rome, where he practised medicine, and delivered public lectures. The friendship of Cardinal Cervini obtained for him the appointment of physician to the pope, Julius III. The death of this personage, and that of Cervini, who had been elevated to the apostolic chair, which, however, he occupied only three weeks, were not productive of any serious disadvantage to him, for he was continued in his offices by Paul IV., to whom he dedicated his work. He died at Rome, in 1572, at the age of fifty-eight.

GUILLAUME RONDELET.

Rondelet greatly surpassed Gesner, Belon, and Salviani, in the extent of his knowledge as an ichthyologist; and although his figures, being only wood-cuts, are inferior in beauty to the copperplate-engravings of the last of these authors, they are yet more correct in the characteristic details. His work is entitled De Piscibus Marinis Libri XVIII., in quibus vivæ piscium imagines expositæ sunt, and was published at Lyons in 1554. A second part appeared in 1555, under the name of Universæ Aquatilium Historiæ Pars Altera, cum veris ipsorum Imaginibus. The first part treats of marine ani-

mals, including the cetacea, turtles and seals, the mollusca, and the crustacea. In the second part, shells, insects, zoophytes, and fresh-water fishes, are described. These objects, although not methodically arranged, are often placed in such a manner as to indicate that the author had some idea of generic affinity. The anatomical details which he presents are pronounced by Cuvier to be frequently correct; but his descriptions, it must be granted, are inferior to the figures, which are truly surprising for the period at which he lived. In reference to the fishes of the Mediterranean this work is indispensable, and, indeed, to the ichthyologist generally it is one of the most important that exists. The descriptions and figures have been copied by Gesner, in his work De Aquatilibus; while Ray, Artedi, and Linnæus, have obviously profited by them.

Rondelet, the son of an apothecary, was born at Montpellier on the 27th September 1507. Being originally of a very infirm constitution, he was judged incapable of performing a part in active life, and, accordingly, when his father's fortune was distributed, he received a sum merely sufficient to procure his admittance into a convent. As he grew up, however, he improved in strength, and having no affection for a monastic life, he commenced his studies at the age of eighteen, and finished his general education at Paris, where he was supported by his elder brother. Having resolved to embrace the medical profession, he returned in 1529 to his native city, and afterwards settling at Pertuis, a small village in Provence, he began to practise; but not meeting with success in the healing art, he endeavoured to procure subsistence by setting up a grammar-school. This

expedient also failing, he went again to Paris in order to improve his knowledge of the Greek language, and, being unwilling to burden his brother any longer, became tutor to a young nobleman. Some time after, he removed to Maringues, in Auvergne, where he again entered upon practice, and in 1537 received a medical degree at Montpellier. The following year he married a young lady endowed with many estimable qualities, but destitute of fortune; and, as his brother was dead, this alliance increased his difficulties. However, he settled finally at the place of his birth; and, being assisted by his wife's sister, began to extend his acquaintance, and succeeded so well in his profession, that, in 1545, he was appointed professor of medicine in the university.

He also obtained the office of physician to the Cardinal of Tournon, whom he accompanied on his missions in France, Italy, and the Low Countries, of which occasions he eagerly availed himself to increase his knowledge of natural history. Returning once more to his usual place of residence he established an anatomical theatre, at which he lectured several hours daily to a numerous audience. His passion for dissection was so strong, that he opened one of his own children after death, and this circumstance has naturally enough given rise to the opinion, that he must have been a man destitute of sensibility; which, however, does not appear to have been the case. His wife having died in 1560, he soon procured another, poor and handsome like the first. While on a journey to Toulouse he was attacked by dysentery, occasioned by eating too many figs, and he died at Realmont, whither he had gone

to visit a patient. His death happened on the 30th July 1566, in the fifty-ninth year of his age.

He was a man of very small stature, but robust and active. At the age of twenty-five he gave up the use of wine and spirits, from an apprehension of gout; but he compensated for his abstemiousness in these articles by indulging his appetite for fruit and pastry. Although he had acquired considerable sums of money in the practice of his profession, he expended them in the gratification of his taste for building, and in various acts of generosity; so that he left very little behind him.

ULYSSES ALDROVANDI.

One of the most celebrated naturalists of the sixteenth century was Ulysses Aldrovandi, professor at Bologna, who was born in that city in 1527, and died on the 4th of May 1605. He was of a noble family, and his fortune enabled him to travel extensively, to collect materials for his books, and to employ artists in painting and engraving suitable illustrations. He carried, indeed, his liberality in this respect so far, that, having expended his whole fortune in his enthusiastic pursuit of natural history, he left nothing for the support of his old age, and is commonly believed to have died in the hospital of his native city. Cuvier, in a notice of his life in the Biographie Universelle, regards this circumstance as doubtful; imagining it improbable that the senate of Bologna, to whom he bequeathed his museum and manuscripts, and who laid out large sums after his death in completing the publication of his works, would have left him destitute during

his life. This, however, is mere conjecture; and there is too much reason to fear that, like many other eminent persons, he was abandoned to struggle with misfortune, and not advanced to honour and estimation until after his career was finished, when they could be of no use to him.

The works of Aldrovandi form thirteen folio volumes. Of these, four only were published by himself; namely, three on birds and one on insects. Immediately after his death, in 1606, his widow put forth a volume on the other white-blooded animals, including testacea and crabs. Cornelius Uterverius, a native of Delft, and his successor in the institute of Bologna, revised the work on fishes and whales, which appeared in 1613, as well as that on the quadrupeds with solid hoofs, published in 1616. In 1621, the History of the Quadrupeds with split Hoofs was edited by Thomas Dempster, a Scottish gentleman, who was also a professor at Bologna. The other treatises, on the viviparous and oviparous digitate quadrupeds, on serpents, monsters, and minerals, were prepared for the press by Bartholomew Ambrosinus, another of his successors, and that on trees by Ovid Montalbanus. These works underwent a second impression at Bologna, and some of them were subsequently printed at Frankfort. It is difficult to procure a uniform edition, and some of the tracts are much rarer than others.

Aldrovandi was certainly one of the most zealous naturalists of his time; but, although he added considerably to the stock of information, he can only be considered as a laborious collector of materials. Cuvier pronounces his works "an enormous compilation without taste or genius," and agrees with

Buffon in thinking, that were the useless parts removed, they would be reduced to a tenth of their bulk. Moreover, the plan and matter are to a great extent borrowed from Gesner; but in all ages writers on natural history have been so much addicted to the practice of borrowing, that Aldrovandi is hardly to be censured on this account.

Some portions of his museum have successfully struggled with the destructive energies of time, and are still to be seen in the collection of the Institute of Bologna. His manuscripts, of which there is an immense mass, are preserved in the public library of the same city; and the drawings from which the engravings for his work were taken were carried, at the time of the Revolution, to the Museum of Natural History at Paris.

Such were the dawnings of zoological science after the revival of learning in Europe. The authors of those times, it is manifest, looked less to nature than to the writings of Aristotle, Pliny, and their other predecessors; so that in their works we find little more than a repetition of what had been previously said. Their descriptions are rude, frequently incorrect, and in few cases characteristic. They had no idea of disposing the objects of which they treated in a manner resembling that to which we have been accustomed since the period of Ray and Linnæus. The alphabetical arrangement was followed by some, while others possessed a rude notion of the affinity of species; but although attempts were made to separate the animal creation into classic groups, yet from the days of Aristotle to those of Swammerdam, Ray, and Reaumur, we find no traces of the anatomical knowledge necessary for the accomplish-

ment of such an undertaking. We have, indeed, little reason to expect in the writings of the ancients, or in those of the succeeding naturalists, any example of a just classification; still we cannot but marvel when we find, that very few of them endeavoured to represent objects as they might have seen them with their own eyes. Whatever may be the causes of this defect, those who are extensively conversant with the publications of our own times must be aware, that the practice of copying from books, instead of having recourse to Nature herself, has not yet been relinquished; though nothing is more clear than that there can be no real progress in natural history without authenticating the observations of preceding writers by examining the objects which they have described, and by noting the particulars in which they are erroneous.

JONSTON, GOEDART, REDI, AND SWAMMERDAM.

Zoologists of the Seventeenth Century.

Brief Account of the Lives and Writings of John Jonston, John Goedart, Francis Redi, and John Swammerdam—Notice respecting the principal Works of Swammerdam—His Birth and Education—He studies Medicine, but addicts himself chiefly to the Examination of Insects—Goes to France, where he forms an Acquaintance with Thevenot—Returns to Amsterdam, takes his Degree, improves the Art of making Anatomical Preparations—Publishes various Works—Destroys his Health by the Intensity of his Application—Becomes deeply impressed with religious Ideas—Adopts the Opinions of Antoinette Bourignon—Is tortured by conflicting Passions—Endeavours to dispose of his Collections—Is affected with Ague and Anasarca, and dies after protracted Suffering—His Writings published by Boerhaave—His Classification of Insects.

JOHN JONSTON.

Of the three kingdoms of nature, the vegetable was that which, down to the time of Linnæus, had received most attention. Mineralogy could scarcely be said to have commenced. Zoology had indeed made considerable progress; but botany had advanced in a still greater degree, having been cultivated by a host of naturalists, chiefly belonging to the medical profession. One of these, Cæsalpinus, who flourished in the end of the 16th century, had already invented a system; whereas Ray, who belonged to the 17th, was the first zoologist who formed a methodical ar-

rangement of animals. It might thus be supposed that the examination of plants is easier, while that of minerals is more difficult, than the study of zoology; but the cause of the preference given to the vegetable economy seems to be connected with the value of herbs as articles of the Materia Medica, while the animal kingdom attracted more attention than the mineral, as exciting greater curiosity, and tending more directly to supply the most urgent wants of man. However this may be, it is certain, that in the 17th century the botanists greatly exceeded the zoologists in number. One of the most remarkable of the latter was the subject of the present notice, who, although merely a compiler, and not possessed of much judgment or taste, continued to be a popular author on natural history until his works were superseded by those of Linnæus.

John Jonston, descended from a family originally Scottish, was born, in 1603, at Sambter, near Lissa, a city of the palatinate of Posen in Poland. After studying at Beuthen on the Oder, and at Thorn in the Prussian dominions, he prosecuted his education at the University of St Andrews; whence, in due time, he returned to his native country, and for three years acted as tutor to the sons of Count Kurtzbach. He then studied medicine and natural history in several of the more distinguished seminaries at home and abroad. In 1632, he took charge of two young noblemen, whom he accompanied to England, Holland, France, and Italy. At Leyden he obtained a medical degree, and was offered a professorship; which, however, he declined, preferring a private life. On completing his travels, he retired to a place in the neighbourhood of Lignitz,

where he spent the rest of his days. He died on the 8th June 1675.

The most important of Jonston's works is his Historia Animalium, which was published at Frankfort on the Maine. The first part, containing five books on fishes and cetacea, and four on the white-blooded aquatic animals, appeared in 1649. The second part, which treats of birds, followed in 1650; the third, on quadrupeds, in 1652; and the fourth, on insects and serpents, in 1653. Several editions of this work have since come out; the latest being that of Heidelberg, in 1755. It is, however, a mere compilation from the writings of Gesner, Aldrovandi, and others. The plates, which are numerous, are also, for the most part, copied from these authors, a few only being original. They are not without merit, having been engraved by the famous Matthew Merian; but several of them, resting on no authority beyond that of simple description, represent objects which have no real existence. His first treatise, which is a collection of the most curious phenomena presented by the sky, the elements, meteors, fossils, plants, birds, quadrupeds, insects, and man, was printed at Amsterdam in 1632, under the title of Thaumatographia Naturalis in Decem Classes Distincta. He also produced a Dendrographia, or natural history of trees and shrubs; and two smaller tracts, the one entitled Notitia Regni Vegetabilis, the other Notitia Regni Mineralis; together with several others, on various subjects, which, as they have long since passed into oblivion, it is unnecessary to mention at greater length.

JOHN GOEDART.

THIS distinguished naturalist was born at Middleburg in Holland, in 1620. He was a sedulous observer of the nature and properties of insects, which he examined with admirable patience and sagacity. His work, which was written in Dutch, was published at Middleburg in 1662, with the title Descriptions of the Origin, Species, Qualities, and Metamorphoses of Worms, Caterpillars, &c. Being a painter by profession, he adorned it with very accurate coloured engravings. The treatise was also printed in Latin and French translations. The former bore this title:—Metamorphosis et Historia Naturalis Insectorum, cum Commentario Jo. de Mey et duplici ejusd. Appendice, una de Hemerobiis, altera de Natura Cometarum. An improved edition, in the English language, was published by Lister in 1682; and another, in Latin, in which the species were methodically disposed, appeared in 1685, under the care of the same naturalist, who had the work reprinted a third time as an appendix to his Historia Animalium Angliæ. Goedart describes 150 different species, and may be considered as the first who subjected the metamorphoses of insects to accurate examination. He died in 1668.

FRANCIS REDI.

THE principal works of this eminent physician, having any reference to zoology, are on the generation of insects, on the poison of the viper, and on intestinal worms. His observations and experiments were translated from the Italian into Latin, and published at

Amsterdam in 1670 and 1686, and at Leyden in 1729. Fabroni gives his life in the third volume of his Vitæ Illustrium Italorum. Sprung from a noble family, he was born at Arezzo on the 18th February 1626. After finishing his studies at the University of Pisa, he settled at Florence, where he soon became known as a successful practitioner, and was appointed physician to Ferdinand II. grand duke of Tuscany, in which office he was continued by Cosmo III. Redi's experiments, directed by professional views, had for their chief object the treatment of the bite of serpents, and the destruction or removal of intestinal worms. His letters, however, published in 1724, in two volumes 4to, are replete with interesting observations in every department of natural history; his poetical works are said to be distinguished by elegance and grace; and his numerous literary compositions are described as evincing a pure and cultivated taste. He was a considerable contributor to the edition of the Dictionary of the Academia della Crusca, printed in 1691. He died at Pisa on the 1st of March 1694, at the age of sixty-eight, and was buried at Arezzo, in a tomb which his nephew decorated with an inscription, remarkable for its simplicity and good taste:—

FRANCISCO REDI PATRITIO ARETINO
GREGORIUS FRATRIS FILIUS.

JOHN SWAMMERDAM.

As a naturalist, Swammerdam is chiefly celebrated for the extent and accuracy of his inquiries into the structure of insects; though anatomy and physiology are equally indebted to his labours. He was the first who discovered the method of rendering the blood-

vessels more easy to be traced in dissection, by injecting them with coloured wax in a fluid state; and although he cannot for that reason alone claim all the discoveries that have been made in anatomy, any more than the first person who skinned birds can claim the honour of determining the numerous species that have been conveyed from distant countries, or he who first cut a slice of petrified wood, all the results that have emanated from his experiment, yet he certainly devised the means of extending our knowledge of the human body as well as of pathology. His works on insects are the following:—1. The General History of Insects, published in Dutch at Utrecht in 1669, and subsequently in French and Latin, in which he gives a classification of these animals, founded on their structure and metamorphoses. 2. The History of the Ephemeris, published in Dutch at Amsterdam in 1675, and in Latin at London in 1681. 3. The Biblia Naturæ, sive Historia Insectorum in Classes Certas Redacta, Leyden, 1737–38, 2 vols folio, which has been translated into German, English, and French. This important work was published after his death by Boerhaave, in Dutch and Latin, and contains a masterly exposition of the structure of such insects as came under his observation.

It has been remarked by an eminent entomologist, that natural history, which, during the long series of ages in which barbarism reigned, shared the fate of the other sciences, underwent the same treatment when a taste for knowledge began to revive. For example, it was chiefly in Aristotle that the history of animals was sought; whereas, if Aldrovandi, Gesner, Moufet, and other physiologists, had studied nature as much

as they studied the ancient writers, the assiduous labour of so many active minds would have secured for that science a more sure and rapid progress. The material world was then observed only for the purpose of confirming the reports made by the authors of antiquity. At length Nature opened the eyes of those who were trying to see in her only what they had seen in Aristotle and Pliny. She disclosed to them facts worthy of being noticed, which they vainly sought in the books which they imagined to contain every thing; and unfolded others, which gave them reason to doubt the truth of those that had been transmitted from former ages. After having thrown off the fetters of authority, farther, perhaps, than was quite consistent with the respect that was really due to the ancients, men perceived that they ought to study facts, verify whatever had been related, and try to discover more. It was thus that Malpighi, Swammerdam, Redi, and other illustrious authors proceeded. Even those, such as Goedart and Madame Merian, who, from an ignorance in some degree fortunate, were unable to read the ancients, laboured with advantage as observers.*

The subject of this memoir was born at Amsterdam on the 12th February 1637. His father, an apothecary, was fond of natural history, and, being in prosperous circumstances, embellished his house with preserved animals, shells, and minerals, insomuch that it became an object of attraction to the curious. Young Swammerdam was intended for the church, and received instructions in the Greek and Latin languages, to qualify him for the study of divinity; but, on seriously consider-

* Reaumur, Histoire des Insectes, tome i. p. 28.

ing the importance of the task designed for him, he judged himself incapable of discharging the duties of a religious instructor. On representing the matter to his parents, he received their permission to commence the study of medicine. Being frequently employed in cleaning and arranging his father's cabinet, he gradually acquired a liking to natural history, and even at an early age began to form a collection of insects, which he disposed into classes, agreeably to ideas derived from observation and the descriptions of authors. Day and night he pursued his favourite employment, searching the woods and fields, the sandhills and muddy shores, the lakes, rivers, and canals, for insects, worms, and mollusca, until he acquired, even while a youth, a more extensive and more accurate knowledge of the lower animals than all the naturalists who had preceded him.

In 1661, he went to Leyden, for the purpose of attending the lectures at the celebrated university of that city. There he remained two years, studying surgery with Van Horne, and medicine with Franciscus Sylvius de le Boe, with as much diligence as he had previously displayed in his other pursuits. During the whole of this time he enjoyed the friendship of Steno and De Graaf; and, becoming much attached to the study of anatomy, he exerted his utmost ingenuity in devising means for effectually preserving his preparations.

He then went to Paris to improve himself in his profession. There he continued the examination of insects, and had the good fortune to discover the valves in the lymphatic vessels. After this he resided for some time at Lyons, where he lived on terms of intimacy with Thevenot the celebrated traveller, who intro-

duced him to the learned men by whom his house was frequented. In their society he usually remained a listener, and could not be prevailed upon to communicate his ideas; but, being repeatedly urged to exhibit one of his minute dissections, he gratified the wishes of his friends, and, by the profound knowledge which he displayed, acquired at once their esteem and admiration. Thevenot recommended him to Van-Beuningen, a senator at Amsterdam, who, on his returning to that city, obtained permission for him to examine the bodies of patients dying in the hospital,—an opportunity of increasing his knowledge which he took care not to neglect.

In his native town he frequented a society of medical men, who met once a-fortnight for the purpose of discussing subjects connected with their profession, and made observations on the structure of the spinal marrow and nerves, on respiration, and on the effects produced by the injection of fluids into the blood-vessels of animals.

About the end of 1666, he returned to Leyden with the view of obtaining his medical diploma, and there continued his researches in company with his former teacher, Van Horne, in whose house he injected the uterine vessels with wax,—a method of showing the distribution of the arteries and veins afterwards greatly improved by him, and which has been productive of much advantage in the study of anatomy. In February 1667, he received the degree of doctor, and in March published his thesis on respiration, which he dedicated to Thevenot. He next invented a new method of preserving anatomical subjects by inflating them with air. But the eagerness with which he engaged in these occupa-

tions was prejudicial to his health, and he was seized with a quartan ague, which reduced him to a state of extreme debility. On recovering from this disease, he remitted his professional studies for two years; resuming the investigation of insects, the structure of which he unfolded with astonishing precision and success.

It happened about this time that the Grand Duke of Tuscany visited Amsterdam. Accompanied by Thevenot, he examined the collections made by Swammerdam and his father, and was so struck by the wonderful dissections of insects that he offered 12,000 florins for the museum, on condition that its proprietor should accompany it to Florence, and take up his residence in the palace. But the young naturalist had been so much accustomed to roam about at will, that he could not relinquish his liberty, and therefore refused the offer.

In 1669, he published his General History of Insects, which he dedicated to the senate of Amsterdam. The expense which he incurred in procuring specimens from all quarters, while no emoluments resulted from his labours, so displeased his father, that he earnestly urged him to relinquish his unprofitable pursuits, and engage in the practice of medicine. At length, finding him unwilling to follow his advice, he was obliged to threaten a total intermission of supplies; though by this time the ardent student had fallen into such a state of debility that he was totally unfit to undergo the fatigues of practice. He was, however, sensible of the propriety of the counsel which was administered to him, and retired to the country to recruit his strength; but he had scarcely arrived when he recommenced his studies, being

wholly unable to resist the temptation offered by solitude and by the presence of the objects which invited his research. In the mean time, Thevenot, being made acquainted with these circumstances, urged him to return to France, generously offering him every thing necessary to enable him to follow the bent of his genius. His father, however, did not approve of this scheme, which was therefore relinquished; but the son did not the less continue to pursue his former occupations.

In 1672, he published his Miraculum Naturæ, seu Uteri Muliebris Fabrica. He soon afterwards entered upon an extensive examination of fishes, having reference chiefly to the pancreas. About this time he began to be impressed with religious ideas; becoming sensible of the vanity of human pursuits, as well as of the sinfulness of that inordinate ambition which impels men to aim at the highest place in the estimation of their fellows. He accordingly resolved to eradicate that base passion from his breast. In this state of mind he imbibed the mystical notions of the celebrated Antoinette Bourignon.

This lady, who was a native of Lisle in Flanders, had become at an early age impressed with the idea that pure Christianity was in a state of decay, and that she was called to revive it. She became governess of the hospital of her native city, and took the order and habit of St Augustin; but owing to the disturbances caused by her violent temper and pretensions to inspiration, the magistrates were obliged to expel her from her office, when she retired to Ghent. The fortune which she inherited from her parents, and that bequeathed to her by her convert De Cordt, enabled her to publish several works of

her own composition, and rendered her, notwithstanding the deformity of her person, the object of much hypocritical admiration. Such was her extreme parsimony, and so inconsistent was her conduct with her professions, that she declared she would rather throw her wealth into the sea than bestow the smallest sum on the poor, or on "beastly persons who had no souls to be saved."

She was at that time in Holstein; and Swammerdam wrote to a friend of his who accompanied her, to obtain permission to consult her in writing respecting his doubts. The result of their correspondence was a resolution on his part no longer to addict himself exclusively to pursuits which had reference to this world only, but to endeavour to make his peace with God. He did not, however, entirely relinquish his anatomical studies, but on the contrary engaged with astonishing ardour in the examination of the structure of bees, which he finished on the last day of September 1674. "He had laboured so assiduously at this work," says Boerhaave, "as to destroy his constitution; nor did he ever recover even a shadow of his former strength." The labour, in fact, was beyond the power of ordinary men: all day he was occupied in examining subjects, and at night described and delineated what he had seen by day. At six in the morning, in summer, he began to receive sufficient light from the sun to enable him to trace the objects of his examination. He continued dissecting till twelve, with his hat removed lest it should impede the light, and in the full blaze of the sun, the heat of which caused his head to be constantly covered with a profuse perspiration. His eyes being continually employed in this strong

light, the effect of which was increased by the use of the microscope, they were so affected by it, that after mid-day he could no longer trace the minute bodies which he examined, although he had then as bright a light as in the forenoon." A month of this excessive labour was necessary to examine and depict the intestines of bees alone; and the investigation of their entire structure cost him much additional labour; and all this was done, with a body debilitated by disease, and a mind agitated by conflicting passions, amid sighs and tears. At one time the bent of his disposition impelled him to investigate the wonderful works of Omnipotence; at another a voice within told him that he ought to set his affections on God alone. After finishing his examination of the structure of bees, he was so affected with remorse, that he gave the manuscript and drawings to a friend, careless what might happen to them. At the same time, however, he wrote two letters to Boccone, on the nature of corals.

These occupations being ended, he was more powerfully impressed than ever with the vanity of human pursuits, and after this period he never engaged in his customary investigations. He acknowledged that hitherto ambition alone had incited him to undergo so many labours, but now resolved to devote the remainder of his life to the cultivation of Christian piety. Being encouraged in this resolution by the approbation of Antoinette Bourignon, he firmly adhered to it; and estimating the annual sum necessary for his subsistence at 400 Dutch florins, he endeavoured to dispose of his collections, which formed the only treasures that he possessed. For this purpose, he applied to Thevenot, who, however, was

unable to find a purchaser in France. He then had recourse to another friend, Nicolas Steno, who had abjured the Protestant faith and was living at Florence, and whom he requested to represent the matter to the Grand Duke of Tuscany, in case he might feel disposed to purchase them. This person advised him to follow his example, relinquish his creed, embrace the Catholic faith, and proceed to Florence, promising that he should induce the duke to accept the offer. Swammerdam replied indignantly, that he would not sell his soul for money.

Being without any fixed occupation, he devoted his leisure to arranging and cleaning the contents of his museum, and writing out a catalogue of them. They consisted of anatomical preparations and insects, of the latter of which there were nearly three thousand distinct species. These were all described and arranged into classes, and the entire structure of many of them had been demonstrated by the most minute dissection. He then published his Treatise on the Ephemeris, which he had commenced when in France, and which is considered as one of the most remarkable productions of any age. He did not, however, venture upon this step without consulting Bourignon. These arrangements completed, he now determined in earnest to lead a holy life, and being desirous of a personal consultation with his directress, he went to Holstein, where he remained with her some time. On returning to Amsterdam, he again endeavoured to dispose of his museum, but without success; and his sister, who had hitherto presided over the domestic establishment, happening at this time to be married, his father resolved upon

living with his son-in-law, so that he was obliged to look out for another residence. On this occasion his allowance was limited to 200 florins, and as he could not find any one to purchase his collection he was reduced to great perplexity. However, a thought struck him that he might apply to an old friend, who had formerly treated him with great kindness; but in this he also failed.

In the following year, his father died, leaving him heir to his property, which was sufficient for his support; but he became involved in disputes with his sister, which, together with his assiduous endeavours to discharge his religious duties, so agitated his mind, that he was again seized with a severe ague. For three entire months he was confined to his bed, and even when the accessions of the fever had become more gentle and less frequent, he still persisted in remaining in the house. In vain did his friends, Sladus, Ruysch, Schrader, Hotton, and Quenellon, urge upon him the propriety of adopting means for improving his health. He would not yield to their proposals; and, when they still persisted, at length maintained an obstinate silence.

Finding all his endeavours to sell his collection fruitless, he determined to expose it to public auction; but before the period arrived, his disease was much aggravated by the various agitations to which his mind was now habitually subject. The fever proved again regular and continuous, the countenance was emaciated, the eyes were sunk, the feet, the legs, and at length the whole body, dropsical. His friends dared not speak to him respecting his former studies, for he detested all allusion to them, and wished to withdraw his mind entirely from earthly con-

cerns. At length, on the 25th January 1670, when he perceived his end approaching, he wrote his will, leaving to Thevenot all his original manuscripts on the history of bees, butterflies, and anatomy, with 52 plates; all of which were at that time in the house of Herman Wigendorp in Leyden, to whom they had been delivered to be translated into Latin. He bequeathed his property to Margaret Volckers, wife of Daniel de Hoest, appointing her and Christopher Wyland his executors. The remainder of his time he spent in devotion, and died on the 17th February.

It was some years before Thevenot obtained possession of the manuscripts, and after his death they passed into various hands, but were bought in 1727 by the illustrious Boerhaave, who arranged and published them in two folio volumes, prefixing a life of the author, from which we have drawn the materials of this notice.

The learned editor gives an interesting account of the instruments and expedients employed by Swammerdam in dissecting insects and other minute animals. When the anatomical preparations, insects, and apparatus, were offered for sale, no purchaser could be found, and the collection was subsequently dispersed. The manuscripts and drawings of the Biblia Naturæ were deposited by Boerhaave in the library of the University of Leyden.

The works of Swammerdam contain more original and accurate observations than those of any naturalist who preceded him, excepting Aristotle. He refuted numerous errors committed by his predecessors, and carried his observations to a degree of minuteness and accuracy truly astonishing; but it is not a little surprising that he succeeded less in de-

scribing the structure of large objects than in delineating the organs of the most minute.

His classification of insects differs very materially from those now in use. The characters of his four classes he derives from the state in which each insect appears after its birth, and those through which it passes before attaining its entire development. In the first he places all those which issue from the egg with nearly the same form as that which they have at the period of their full growth; such as spiders, slugs, leeches, &c. In the second are included those which, like the grashopper, issue with six feet, and some time after cast off the covering under which the wings were concealed. These insects run or leap with agility in their first stage, which is not the case with those of the next class. To the third are referred insects which undergo greater changes, such as caterpillars, and which proceed from the egg in the state of a worm, remain in that state for some time, cast off their hairy covering, assume the form of a chrysalis, when they become motionless, and finally emerge in a winged state. The fourth class consists of such as, like the common fly, on changing the form under which they issued from the egg to assume that of a worm, do not cast their covering, but become separated from it, while it remains and forms a shell or egg-like investiture, in which the insect remains in the pupa state until it finally emerges with wings.

The history of Swammerdam must excite our sympathy and commiseration; but that, as some have alleged, he lost his reason towards the end of his life, and became subject to mania, arising from religious melancholy, no one who has any share of

that piety which he evinced will feel disposed to admit. Although he lived in misery, the close of his life was perhaps more enviable than that of many who have gone smiling to their final rest; and it is well for those who, before the period arrives when as the tree falls so it must lie, can like him become truly sensible of the vanity of all earthly pursuits, even although after death they should be pointed out as the victims of a distempered imagination.

RAY.

Account of the Life and Writings of Ray.

Birth and Parentage of Ray—He receives the Rudiments of his Education at Braintree School—At the age of Sixteen enters at Katherine Hall, Cambridge—Removes to Trinity College, where he passes through various Gradations, and becomes a Fellow—Publishes his Catalogue of Cambridge Plants, and undertakes several Journeys—Extracts from his Itineraries—Resigns his Fellowship—Becomes a Member of the Royal Society—Publishes his Catalogue of English Plants, &c.—Death of his most intimate Friend, Mr Willughby—Character of that Gentleman—Mr Ray undertakes the Education of his Sons, and writes a Vocabulary for their Use—Notice of Dr Lister—Several Works published by Mr Ray, who improves and edits Willughby's Notes on Birds and Fishes—Continues his scientific Labours—Remarks on the Scoter and Barnacle—Letters of Dr Robinson and Sir Hans Sloane—Notice respecting the latter—Publication of the Synopsis of British Plants, the Wisdom of God manifested in the Works of Creation, &c.—Estimate of the Number of Animals and Plants known—Synopsis of Quadrupeds and Serpents—Classification of Animals—Various Publications—Ray's Decline—His last Letter—His Ideas of a Future State, and of the Use of the Study of Nature—His Death, Character, and principal Writings.

THE distinguished individual whose history we are about to sketch, and who is considered by many persons of the present age as the greatest naturalist that Britain has yet produced, was born on the 29th November 1628, at Black Notley, near Braintree in Essex. His father, Roger Wray, was a blacksmith, —a circumstance which affords another proof that

natural history has had among its most successful cultivators men of all stations in society, from the lowest to the highest. He received the rudiments of his education at Braintree School, under the care of a Mr Love, who, it seems, was but indifferently qualified for his office. Young Wray, however, profited so well by his opportunities of acquiring knowledge, that at the age of sixteen he was sent to the University of Cambridge, where he entered at Katherine Hall in June 1644. As it is not stated that on this occasion he had to draw on the generosity of any of his rich neighbours, it is to be presumed that his father was in prosperous circumstances. At the end of a year and three-quarters he removed to Trinity College, where he had the good fortune to have for his tutor Dr Duport, a man of great learning, under whose direction he acquired considerable skill in the Latin, Greek, and Hebrew languages. About three years afterwards he was chosen Minor Fellow of Trinity, at the same time with his friend the celebrated Isaac Barrow; and, after passing through the usual gradations, was appointed Greek lecturer of the College in October 1651, Mathematical lecturer in October 1653, and Humanity reader in October 1655. After this he was made Prælector Primarius, Junior Dean, and College Steward, having been sworn into the latter office in 1659.

During the time of Mr Wray's residence at the university, he had several gentlemen of great merit under his tuition. He also became eminent as a pulpit orator, being, according to the testimony of Dr Tenison, archbishop of Canterbury, "much celebrated for his preaching solid and useful divinity, instead of that enthusiastick stuff, which the

sermons of that time were generally filled with." He contracted an intimate friendship with Mr John Nid, who, like himself, was an ardent "admirer of the works of God," and whom, in a funeral sermon, he eulogizes for his admirable amenity and candour, his strict probity, innocence of life and manners, singular modesty, and great learning. He was aided by this gentleman in writing his Catalogue of Cambridge Plants, which he published in 1660, and which was found of great use in promoting the much-neglected study of botany at that university. But before it was entirely finished, he was deprived of the companion whose society had afforded him so much delight.

The favourable reception given to the work now mentioned, encouraged Mr Wray to prosecute his researches with more vigour, and induced him to extend his excursions through the greater part of England and Wales, as well as over a portion of Scotland. On these journeys or "simpling voyages," as he calls them, he was usually accompanied by some of his friends, and in particular by his pupil, Mr Willughby. The notes made on these hurried expeditions were afterwards published by Mr George Scott, under the title of "Select Remains of the learned John Ray;" and as they are not deficient in interest, one or two extracts from them may be not misplaced here:

"August the 17th (1661), we travelled to Dunbar, a town noted for the fight between the English and Scots. The Scots generally (that is the poorer sort) wear, the men blue bonnets on their heads, and some russet; the women only white linen, which hangs down their backs as if a napkin were pinned about them. When they go abroad, none

of them wear hats, but a party-coloured blanket, which they call a plad, over their heads and shoulders. The women generally to us seemed none of the handsomest. They are not very cleanly in their houses, and but sluttish in dressing their meat. Their way of washing linens is to tuck up their coats, and tread them with their feet in a tub. They have a custom to make up the fronts of their houses, even in their principal towns, with firr boards nailed one over another, in which are often made many round holes or windows to put out their heads. In the best Scottish houses, even the king's palaces, the windows are not glazed throughout, but the upper part only, the lower have two wooden shuts or folds to open at pleasure, and admit the fresh air. The Scots cannot endure to hear their country or countrymen spoken against. They have neither good bread, cheese, nor drink. They cannot make them, nor will they learn. Their butter is very indifferent, and one would wonder how they could contrive to make it so bad. They use much pottage made of coal-wort, which they call keal, sometimes broth of decorticated barley. The ordinary country houses are pitiful cots, built of stone, and covered with turves, having in them but one room, many of them no chimneys, the windows very small holes, and not glazed. In the most stately and fashionable houses, in great towns, instead of cieling, they cover the chambers with firr boards, nailed on the roof within side. They have rarely any bellows, or warming-pans. It is the manner in some places there, to lay on but one sheet as large as two, turned up from the feet upwards. The ground in the valleys and plains bears good corn, but especially

beer-barley, or bigge, and oats, but rarely wheat and rye. We observed little or no fallow-grounds in Scotland; some layed ground we saw, which they manured with sea-wreck. The people seem to be very lazy, at least the men, and may be frequently observed to plow in their cloaks. It is the fashion for them to wear cloaks when they go abroad, but especially on Sundays. They lay out most they are worth in cloaths, and a fellow that hath scarce ten groats besides to help himself with, you shall see come out of his smoaky cottage clad like a gentleman."

That this is a true character of the people of the southern division of Scotland in those days is very probable;—it is needless to say that things are much altered now. Still the picture applies in almost every particular to the inhabitants of several districts at the present day, although the men seldom plough in their plaids; but as the Scots cannot (any more than the English) endure to hear their country spoken against, we desist from making any reflections, merely wishing that they would strive to render it such as to merit the utmost praise.

The next extract which we shall present, has a reference to the Bass Rock, in the estuary of the Forth:

"August the 19th, we went to Leith, keeping all along on the side of the Fryth. By the way we viewed Tantallon Castle, and passed over to the Basse Island; where we saw, on the rocks, innumerable of the soland geese. The old ones are all over white, excepting the pinion or hard feathers of their wings, which are black. The upper part of the head and neck, in those that are old, is of a yellowish dun colour. They lay but one egg a-piece,

which is white, and not very large. They are very bold, and sit in great multitudes till one comes close up to them, because they are not wont to be scared or disturbed. The young ones are esteemed a choice dish in Scotland, and sold very dear (1s. 8d. plucked). We eat of them at Dunbar. They are in bigness little inferior to an ordinary goose. The young one is upon the back black, and speckled with little white spots, under the breast and belly grey. The beak is sharp-pointed, the mouth very wide and large, the tongue very small, the eyes great, the foot hath four toes webbed together. It feeds upon mackrel and herring, and the flesh of the young one smells and tastes strong of these fish. The other birds which nestle in the Basse are these; the scout, which is double ribbed; the cattiwake, in English cormorant; the scart, and a bird called the turtle-dove, whole-footed, and the feet red. There are verses which contain the names of these birds among the vulgar, two whereof are,

> 'The scout, the scart, the cattiwake,
> The soland goose sits on the lake,
> Yearly in the spring.'

"We saw of the scout's eggs, which are very large and speckled. It is very dangerous to climb the rocks for the young of these fowls, and seldom a year passeth, but one or other of the climbers fall down and lose their lives, as did one not long before our being there. The laird of this island makes a great profit yearly of the soland geese taken; as I remember, they told us £130 sterling. There is in the isle a small house, which they call a castle; it is inaccessible, and impregnable, but of no great consideration in a war, there being no harbour, nor

any thing like it. The island will afford grass enough to keep thirty sheep. They make strangers that come to visit it *Burgesses of the Basse,* by giving them to drink of the water of the well, which springs near the top of the rock, and a flower out of the garden thereby. The island is nought else but a rock, and stands off the land near a mile; at Dunbar you would not guess it above a mile distant, though it be thence at least five. We found growing in the island, in great plenty, *Beta marina, Lychnis marina nostras, Malva arborea marina nostras, et Cochlearia rotundifolia.*"

In this sketch, short as it is, there are several inaccuracies, and yet it is on the whole more correct than some later accounts of the same interesting islet.

On the restoration of Charles II., when there was a prospect of peaceable times, and the church of England was re-established, Mr Wray took orders, though he continued a fellow of Trinity College. But his views of preferment were blasted by his resolution not to subscribe to the conditions implied in the Act of Uniformity, by which divines were required to declare that the oath entitled the Solemn League and Covenant was not binding on those who had sworn it. The reason of his refusal did not, however, arise from his having himself taken the oath, which he never did, having always believed it to be unlawful, but from his considering those who had taken it as still under an obligation to abide by it. In consequence of this opinion he deemed it proper to resign his fellowship in 1662.

On leaving Cambridge he resolved to go to the Continent, with the view of extending his know-

ledge of natural history, to which he had long been devoted. Accordingly, in the spring of 1663, accompanied by Mr Willughby, Mr Skippon, and Mr Bacon, his pupils, he crossed to Calais, and traversing the Low Countries, visited Germany, Italy, and several islands in the Mediterranean. In returning homewards he directed his way through Switzerland and France, and arrived in his own country in the spring of 1666, with a rich store of materials for the cultivation of his favourite science. He now occupied himself in reading the works that had been published during his absence; in reviewing and arranging Mr Willughby's collections; and in making a catalogue of such plants as were natives of the English soil. He was also employed during the winter in forming a table of plants and quadrupeds to illustrate the famous work of Dr Wilkins on a "Real or Universal Character." In the summer of 1667, he made a journey into the west, accompanied by his favourite pupil. While on this excursion the two friends described many natural objects, and in particular examined the Cornish mines, and the methods employed for smelting ores.

His fame as a naturalist being now fully established, he was solicited to become a member of the Royal Society, which he accordingly entered in 1667. The remainder of this year he spent with his friends in Sussex and Warwickshire. In 1668, he made a journey into Yorkshire and Westmoreland, where he assiduously exerted himself in collecting plants and animals. The greater part of the winter was passed in Warwickshire, with Mr Willughby, who in the following spring engaged with him in a series of experiments on the ascent and descent of

the sap in trees, the results of which were published in the Philosophical Transactions.

Although botany seems to have been his principal study, his attention was by no means confined to it, for, like most naturalists of the time, he was a general collector. The materials which he had accumulated in the course of his journeys having now increased to a great extent, he began to digest his observations; commencing, rather oddly, with a set of proverbs, which he made ready for the press, although they were not published till 1672. In 1669, he also prepared his Catalogue of English Plants, which was printed in the following year.

At this time he changed his name to Ray, omitting the initial letter; the altered mode of spelling being, as he conceived, more correct. In one of his notes to Dr Lister he mentions his having had an offer of L.100 per annum to travel with three young noblemen, expressing, at the same time, his unfitness for the office, and his unworthiness of so large a salary. To this his friend replies: "I joy you of the condition offered you. If you accept it, I wish you all the satisfaction and comfort in the world of it; and I pray God, of his infinite mercy, to preserve you in your travels, and to send me home again my dear friend well. Fix not long with them in any place; for the gentry of France are very proud, and will soon (when acquainted) learn them to despise their tutors, however well deserving." This proposal, however, Mr Ray rejected, being in a weak state of health, and considering it more expedient to continue his pursuits.

In the spring of 1671, he had an attack of jaundice, of which, as he informs Dr Lister, he

"got pretty well rid." On recovering, he pursued his experiments on the motion of sap, and in summer visited several of his acquaintances; after which, in July, he commenced a journey to the northern counties, taking with him Thomas Willisel, from whose assistance in collecting and describing plants he derived much profit.

In this erratic mode of living,—at one time wandering over the country in quest of its rarer productions, at another residing with his friends at their country-seats, enjoying their conversation, and deriving instruction from the inspection of their collections,—Mr Ray must have experienced much real happiness; one principal source of which, however, was now dried up. He had scarcely returned from his excursion when he was informed of the dangerous illness of Mr Willughby, who, having been seized with violent pain in his head, followed by pleurisy and fever, expired in the thirty-seventh year of his age, on the third day of July 1672.

The character of this estimable man and excellent naturalist cannot be better described than in Dr Derham's words:—"His example deserves the imitation of every person of great estate and honour. For he was a man whom God had blessed with a very plentiful estate, and with excellent parts, capable of making him useful to the world. And accordingly he neglected no opportunity of being so. He did not (as the fashion too much is) depend upon his riches, and spend his time in sloth or sports, idle company-keeping, and luxury; but practising what was laudable and good,—what might be of service to mankind. And among other

virtuous employments, one he much delighted in was the searching after, and describing of, animals (birds, beasts, fishes, and insects), which province he had taken for his task, as Mr Ray had that of plants. And in these matters he was a great master, as he was also in plants, fossils, and, in short, the whole history of nature; to which I may add that of coins, and most other curious parts of learning. And in the pursuit and acquest of this knowledge he stuck neither at any labour or cost. Noble monuments of which he left behind him in those posthumous pieces which Mr Ray afterwards published."

To render a separate article unnecessary, some particulars may here be given respecting that distinguished individual. He was born in Lincolnshire in 1635, and, as has already been mentioned, studied at Trinity College, Cambridge, under the tuition of Ray, whose most intimate friend he continued to be until the period of his premature and lamented death. Dr Derham states, from a conversation which he had with Ray a short time before his last illness, that "these two gentlemen, finding the history of nature very imperfect, had agreed between themselves, before their travels beyond sea, to reduce the several tribes of things to a method; and to give accurate descriptions of the several species, from a strict view of them." Both entered upon the task with an enthusiasm which could have been excited only by an intense love of nature, and although Ray was more successful in the event, Willughby was not less industrious during his short career. Ornithology and ichthyology seem to have been his favourite studies, and in prosecuting

them he formed an extensive museum, not, however, excluding other objects. In 1668, he married the daughter of Sir H. Bernard, and settled at Middleton Hall in Warwickshire, where he continued his researches under the eye of his former tutor. His untimely death prevented the publication of his several essays, which were left to the care of Mr Ray, who was also one of the executors of his will. As a special mark of his friendship, besides bequeathing an annuity of £60, he confided to him the education of his two sons, Francis and Thomas, the first of whom died before attaining his twentieth year. The younger was one of the twelve peers created on the same day by Queen Anne, on which occasion he received the title of Lord Middleton.

Mr Ray accordingly betook himself to the instruction of these two young gentlemen, the eldest of whom was only four years of age at the period of their father's decease. For their improvement he composed his Nomenclator Classicus, which was published in 1672, and which, with respect to the names of natural objects, was much more accurate than any that had previously appeared. Having resolved to discharge his duties with fidelity, he was obliged to give up the thoughts of another botanical excursion which he had meditated, as well as to refuse the invitation of Dr Lister, who wished him to live in his house at York.

This eminent physician and naturalist, who was one of Ray's most intimate friends, was born, in 1638, in the county of Buckingham. He was educated at St John's College, Cambridge, and having chosen the medical profession, settled at York as a practitioner. In the year 1683, he removed to

London, when he took the degree of doctor at Oxford, and was elected a Fellow of the Royal College of Physicians. Having, in 1698, attended the Earl of Portland on his embassy to France, he published, when he returned, an account of the journey, which was ridiculed by Dr William King in a parody, in consequence of the minute observations in natural history which it contained. In 1709, he was made physician in ordinary to Queen Anne; but he occupied this post only two years, as he died in February 1711. Omitting his medical writings, which are not of much importance, we may observe, that besides composing several papers which were printed in the Philosophical Transactions, he published the following works on shells, which are referred to by the naturalists of the present day as important productions:—

Historia Animalium Angliæ, with three tracts on spiders, land and fresh-water shells, and marine shells, together with fossils having the form of shells. 4to, London, 1678.

Exercitatio Anatomica de Cochleis. 8vo, 1694. Exercitatio Anatomica Altera, de Buccinis Fluviatilibus et Marinis. 8vo, 1695. Exercitatio Anatomica tertia Conchyliorum Bivalvium. 4to, 1696.

Historiæ sive Synopsis Conchyliorum libri iv., 2 vols folio, 1685–1693. An edition was published, in 1770, by Mr Huddesford, keeper of the Ashmolean Library at Oxford. Of this work there is a new impression by Mr Dillwyn, with a scientific index. The plates of the Historia Conchyliorum were executed from drawings by his daughters, and are in general accurate.

As a specimen of the correspondence which na-

turalists hold with one another, we may present the following letter to Mr Ray:—

"Sir,—August 18, I passed through Marton Woods, under Pimco-Moore, in Craven. In these woods I then found very great plenty of *Mushromes*, and many of them then wither'd, and coal-black; but others new sprung and flourishing. They are some of them of a large size, and yet few much bigger than the *Champignon* or *ordinary red-gilled eatable Mushrome*, and very much of the shape of that; that is an exactly round cap, or crown, which is thick in flesh, and open deep gills underneath; a fleshy, and not hollow, round foot-stalk, of about six fingers breadth above ground, and ordinarily as thick as my thumb. The foot-stalk, gills, and cap, all of a milk-white colour. If you cut any part of this *mushrome*, it will *bleed* exceeding freely and plentifully a pure white juice. Concerning which, note,

"1. That the youngest did drop much more plentifully and freely than those that were at their full growth and expansion. That the dried and withered ones had no signs of milk in them that I then discern'd.

"2. That this milk tastes and smells like pepper, and is much hotter upon the tongue.

"3. That it is not clammy or roapy to the touch.

"4. That although I used the same knife to cut a hundred of them, yet I could not perceive all that time, that the milk changed colour (as is usual with most vegetable milks) upon the knife blade.

"5. That it became, in the glass viol I drew it into, suddenly concrete and stiff, and in some days

dried into a firm cake, or lump, without any *serum* at all.

"6. That it then also, when dried, retained its keen biting taste, as it does at this day, yet not so fierce: Its colour is now of a yellowish green, yet very pale.

"7. This milk flows much faster from about the outmost rimm, or part equivalent to the bark of plants, than from the more inward parts, &c.

"8. I observed these *mushromes* even then, when they abounded with milk (not to be endured upon our tongues) to be exceeding full of *fly*-maggots; and the youngest and tenderest of them were very much eaten by the small grey naked snail.

"You can tell me what author describes this mushrome, and what he titles it.

"I have revised the History of Spiders, and added this summer's notes. Also I have likewise brought into the same method the land and fresh water snails, having this year added many species found in these northern lakes. And by way of Appendix, I have describ'd all the *shell-stones* that I have anywhere found in England, having purposely viewed some places in Yorkshire where there are plenty. The tables of both I purpose to send you. I am not so throughly stocked with sea-shells as I wish and endeavour. I aim not at exoticks, but those of our own shores. Concerning *St Cuthbert's Beads*, I find 3 species of them in Craven: and this makes it plain, that they have not been the back-bone of any creature, because I find of them ramous and branched like trees.

"York, October 12, 1672."

Soon after Mr Willughby's death, Mr Ray lost

another of his best friends, Bishop Wilkins, who died on the 19th November 1672. Being thus deprived of some of those persons whose intercourse had afforded him the purest pleasure, he began to think of consoling himself by marriage; having formed an attachment to a young woman recommended by her personal and mental accomplishments. She was the daughter of Mr John Oakeley of Launton, in Oxfordshire. They were married in Middleton Church, on the 5th June 1673. This lady gave him important assistance in educating Mr Willughby's children; and afterwards, by her unremitting attentions and constant affection, contributed to enliven his mind, when he was labouring under the pressure of protracted disease.

In the year just named, he published an account of the observations which he had made in his travels on the Continent, to which was appended a catalogue of plants observed in foreign countries, and also, about the same time, his Collection of Unusual or Local English Words, adding to it a catalogue of English birds and fishes, and an account of the way of smelting and refining metals and minerals. Mr Oldenburgh, the secretary of the Royal Society, having solicited him by numerous letters to communicate any discoveries which he might have made, he sent several papers, some of which were printed in the Philosophical Transactions, as well as a discourse concerning seeds and the specific differences of plants, which was read to the members.

In 1674 and the following year, he was busily engaged in the task of preparing for the press Mr Willughby's observations on birds. These notices had been committed to paper without any method,

and left in a very imperfect state, so that the trouble of revising and digesting was of no light kind. Without at all detracting from the merits of the author, whose labours, according to Dr Derham, were such, "that he allowed himself little or no time for those recreations and diversions which men of his estate and degree are apt to spend too much of their time in, but prosecuted his design with as great application, as if he had been to get his bread thereby," it may fairly be presumed, and indeed has been generally admitted, that the greater part of his works belong in fact to Mr Ray, who, however, claimed no merit in the performance. The book was published in 1676, in Latin, with engravings, which, in the titlepage, are designated as *icones elegantissimi et vivarum avium simillimi*, although few who inspect them will be disposed to concur in the opinion now stated. It was afterwards translated into English by his affectionate editor, and put forth with large additions in the year 1678. Derham apologizes for the inferior execution of the plates, which were done at the charge of the author's widow. "Considering," says the Doctor, "how well the engravers were paid for their labour, it is great pity they had not had some able person in London to have supervised them, that they might have given better likenesses to the birds than what most of them have. But this is what Mr Ray could only complain of, but not help, by reason of his being in Warwickshire, at a distance from London, where every thing was transacted by letters,—a method which could never afford sufficient directions in a matter of that nature." The descriptions, however, are in general excellent,

regard being had to the state of science at the time when they were written. Some of them, indeed, are very imperfect, and there is, besides, a deficiency of method, which becomes more striking when they are compared with those of Temminck or Selby, or any other of our best modern ornithologists.

In this important work birds are divided into *Terrestrial* and *Aquatic*. The former are disposed in the following order:—

In the first place, land-birds are either furnished with hooked-bill and claws, or have these organs nearly straight.

Those with hooked-bill are carnivorous and predatory or frugivorous. The former are either diurnal, that is, hunt by day, or nocturnal, seeking their food by night.

The diurnal carnivorous birds are either large, as the *eagles* and *vultures*, or small. Of the former there are two kinds, the *generous*, as the peregrine falcon, lanner, goshawk, &c.; and the *ignoble*, as the buzzard, kite, &c. The smaller predatory birds are the *shrikes*, and birds of paradise.

The nocturnal birds of prey are the *owls*.

The *frugivorous* birds with hooked-bill are the *macaws*, *parrots*, and *parrakeets*.

Those having the bill and claws nearly straight, are divided into large, middle-sized, and small. The large are the *ostrich*, *emeu*, and *dodo*; the middle-sized are the *crows* and *woodpeckers*, *peacock*, *pigeons*, &c.; the small are such birds as the *swallow* and *lark*, which have the bill slender, and the *sparrow*, *greenfinch*, &c., in which it is thick.

The *aquatic* birds are of two kinds; some frequent watery places, without being capable of

swimming, while others betake themselves to the water.

Of the former some are large, as the crane; others of smaller size. The latter either live on fish, as the *heron, spoonbill, stork, ibis,* &c., or search for insects in the mud, as the *oyster-catcher, plover, sandpiper,* &c.

Of the swimming water-birds some have the toes separated, as the *coot* and *water-hen;* while in others they are united by membranes. The web-footed birds are either long-legged, as the *flamingo* and *avocet,* or furnished with short legs. Of the latter some have three toes, as the *penguin, auk,* &c.; others have four. The four-toed aquatic birds either have all the toes webbed, as the *pelican, gannet, cormorant,* &c., or have the hind toe loose. Of the latter some have a narrow bill, which is hooked at the tip in the *merganser* and *albatross,* or acute and straight in the *divers* and *gulls.* Others have the bill broad, as *geese* and *ducks.*

Of the figures which accompany the descriptions there certainly are not ten that bear a tolerably accurate resemblance to their originals; but, in criticizing ornithological plates, we are apt to forget that it was not until Audubon displayed his drawings that artists began to see how well nature might be imitated.

Mr Willughby's sons having been withdrawn from Mr Ray's inspection, in 1675, he left Middleton Hall where he had resided, and removed with his wife to Sutton Cofield, about four miles distant, where he continued till Michaelmas 1677, when he went to Falborne Hall in Essex, near his native place. In the course of his residence there his

mother died, to whom he was affectionately attached, and of whom he says that she stuck constantly to her profession, and never "left the church in these times of giddiness and distraction." Immediately after this event he repaired to Black Notley, where he resolved to remain during the "short pittance of time he had yet to live in this world."

He now finished his Methodus Plantarum Nova, which was published in 1682; and laboured at his Historia Plantarum Generalis, of which the first volume appeared in 1686, the second in the following year, and the third in 1704. In compiling this great work, he received much valuable assistance from his friends, but more especially from Sir Hans Sloane and Dr Tancred Robinson. With respect to the former of these publications, it may be stated, that it was founded upon the labours of his predecessors, such as Cæsalpinus and Jungius, as well as on the writings of Morison, whose method he principally followed. He divided plants into woody and herbaceous. The woody kinds he again divided into trees and shrubs, distinguishing the trees by their possessing buds, which he showed to be, in fact, new plants annually springing from the old ones. The families were better defined, the classes characterized with more precision, and various terms introduced which were of great advantage as tending to render the language of botany more appropriate. The General History of Plants is his most celebrated work on the vegetable kingdom. In it he describes with considerable exactness and perspicuity all the species which his predecessors had made known, adding those that had been discovered in his own time. All botanists who have spoken of this work agree in

considering it as one of immense labour, although, as the greater part was avowedly borrowed from other writers, it has not the advantage of ranking among those that have resulted from original observation.

About the same time he revised and arranged Mr Willughby's papers relative to fishes, which, being put in order for the press, and communicated by Dr Robinson to the Royal Society, were published at the charge of that learned body; the engravings having been executed at the expense of several of the members. This important treatise appeared in 1686.

Besides all the species of Belon, Rondelet, Gesner, Aldrovandi, Olina, and Margrave, says an eminent ichthyological writer, there are in these works a great number which Willughby and Ray had observed in Germany and Italy. The fishes of the Mediterranean in particular are described with great accuracy, and it is often easier to trace them in their volumes than in Linnæus. To these two works are appended numerous figures, most of which are only copies, although there are some very good original ones among them. Even such of them as are borrowed from Belon and Rondelet acquire an interest from the descriptions which accompany them, and which are much superior to those of the French writers.

Dr Robinson appears, by his notices contained in the "Philosophical Letters between the late learned Mr Ray and several of his ingenious Correspondents," to have been of considerable use to our author in transmitting information on every subject that seemed interesting to the latter, and especially

* Biographie Universelle, art. Ray, tome xxxvii. p. 161.

in procuring objects for description. In one of his communications from Geneva is a passage respecting the celebrated Malpighi, which exhibits the character of that great anatomist in a favourable light:—"I had several conferences with S. Malpighi at Bononia, who expressed a great respect for you, and is not a little proud of the character you give him in your Method. Plantar. Nov., which book I had presented him withal a day before. Just as I left Bononia I had a lamentable spectacle of Malpighi's house all in flames, occasioned by the negligence of his old wife. All his pictures, furniture, books, and manuscripts, were burnt. I saw him in the very heat of the calamity, and methought I never beheld so much Christian patience and philosophy in any man before; for he comforted his wife, and condol'd nothing but the loss of his papers, which are more lamented than the Alexandrian Library, or Bartholine's Bibliothece at Copenhagen."

Of the epistolary correspondence of this gentleman, and of Sir Hans Sloane, it may be interesting to some of our readers to peruse a specimen:—

DR ROBINSON TO MR RAY.

"London, August 1, —84.

"SIR,—I have sent you two *Macreuses*, male and female, and hope they will come safe to Black Notley. My ingenious and worthy friend Mr Charlton (now at London) procur'd them for me at Paris, who hath them both design'd to the life in proper colours by the most accurate hand in France. If you saw the pictures I believe they would give you a better insight than these skins, which are a little broke and chang'd; yet never-

theless your most discerning faculties may discover that in the dark which few can distinguish at noonday. This Parisian bird (very famous of late) may be no unwelcome subject, it being in Lent, and upon maigre days, the greatest dainty of convents. I have been told by several of the most learned priests beyond sea, that the macreuse was as much a fish as the barnacle (and indeed I am of the same opinion), that the blood was the same in every quality with that of fishes; as also the fat, which (as they falsely affirm) will not fix, dry, or grow hard, but always remains in an oily consistence. Upon these and other reasons the Sorbonists have ranked the macreuse in the class of fishes. For the rest I refer you to my paper from Paris, and impatiently wait for your judgment, for which I have a particular esteem."

The bird referred to in this letter, and concerning which Mr Ray had not previously been able to satisfy himself, is the scoter or black-duck (*Anas nigra* of Linnæus, Latham, and Temminck). "Why they of the Church of Rome should allow this bird to be eaten in Lent, and upon other fasting days, more than others of this kind," we see no reason, any more than Mr Ray did. Perhaps the story of the barnacle's originating from a shell of the same name, may have been invented for a similar purpose. On this head we have the following testimony from Hector Boëce:—"All trees that are cast into the seas, by process of time, appear first worm-eaten, and in the small holes and bores thereof grow small worms; first, they show their head and feet, and last of all they show their plumes and wings; finally,

when they are coming to the just measure and quantity of geese, they fly in the air as other fowls do, as was notably proven in the year of God 1480, in sight of many people, beside the Castle of Pitsligo." The evidence of Gerard, the herbalist, on this subject is an excellent specimen of leasing:—"What our eyes have seen," saith the venerable man, "and our hands have touched, we shall declare. There is a small island in Lancashire, called the Pile of Soulders, wherein are found broken pieces of old and bruised ships, some whereof have been cast thither by shipwrecks; also the trunks and bodies, with the branches, of old and rotten trees, cast up there likewise, whereon is found a certain spume or froth, that in time breedeth into certain shells, in shape like those of the muscle, but sharper-pointed, and of a whitish colour, and the end whereof is fastened unto the inside of the shell, even as the fish of oysters and muscles are, and the other end is made fast unto the belly of a rude mass or lump, which, in time, cometh into the shape and form of a bird. When it is perfectly formed, the shell gapeth open, and then the first thing that appeareth is the aforesaid lace or string; next cometh the legs of the bird hanging out; and, as the bird groweth greater, it openeth the shell by degrees, till at length it has all come forth and hangeth only by the bill. In short space after it cometh to full maturity, and falleth into the sea, where it gathereth feathers, and groweth to a fowl, bigger than a mallard, and lesser than a goose, having black legs and bill or beak, and feathers black and white, spotted in such manner as our magpie, called in some places pie-annes, which the people of Lancashire call by no other

name than tree-goose; which place aforesaid, and all those places adjoining, do so much abound therewith, that one of the best is bought for three-pence. For the truth hereof, if any doubt, may it please them to repair to me, and I will satisfy them by the testimonies of good witnesses."

Now the whole substance of this wondrous narrative is simply this:—There is a species of goose called barnacle, and there is a species of cirripedous animal or shellfish bearing the same name. The latter animal is furnished with certain filamentary organs which may be imagined to bear a semblance to feathers; and hence the conclusion that it must be a bird in the progress of development, which is finally converted into a goose. A refutation of the inference here made does not require the acuteness of an Aristotle. Gerard saw the shells, no doubt, but the rest he dreamt; and the good people beside the Castle of Pitsligo may have seen a flock of geese, but what else they saw nobody cares. But let us now hear Sir Hans.

Sir Hans Sloane to Mr Ray.

"London, March 9, 169⅝.

"Sir,—This day a large tyger was baited by three bear-dogs, one after another. The first dog he kill'd; the second was a match for him, and sometimes he had the better, sometimes the dog; but the battle was at last drawn, and neither car'd for engaging any farther. The third dog had likewise sometimes the better, and sometimes the worse of it; and it came also to a drawn battle. But the wisest dog of all was a fourth, that neither by fair means nor foul could be brought to go within reach of the tyger, who was chain'd in the middle of a

large cock-pit. The owner got about £300 for this show, the best seats being a guinea, and the worst five shillings. The tyger used his paws very much to cuff his adversaries with, and sometimes would exert his claws, but not often; using his jaws most, and aiming at under or upper sides of the neck, where wounds are dangerous. He had a fowl given him alive, which, by means of his feet and mouth, he very artfully first pluck'd, and then eat, the feathers, such as got into his mouth, being troublesome. The remainders of his drink, in which he has lapp'd, is said by his keeper to kill dogs and other animals that drink after him, being, by his fome, made poisonous and ropy. I hope you will pardon this tedious narration, because I am apt to think 'tis very rare that such a battle happens, or such a fine tyger is seen here."

Ray had many other correspondents besides those of whom mention has been made. Their communications, however, seem neither very interesting in themselves, nor so closely connected with our narrative as to render it necessary to introduce any extracts. But, as we have given some samples of his friends' letters, it may be thought right to present one of his own.

MR RAY TO DR ROBINSON.

"Black Notley, Dec. 15, —90.

"SIR;—The essay you propound concerning the ancient and modern learning were not difficult to make; but I think you are better qualified for such an undertaking than I, and therefore shall refer it to you. In summe the ancients excel the

moderns in nothing but acuteness of wit and elegancy of language in all their writings, in their poetry and oratory. As for painting and sculpture, and musick and architecture, some of the moderns I think do equal, if not excel, the best of them, not in the theory only, but also in the practice of those arts: Neither do we give place to them in politicks or morality; but in natural history and experimental philosophy we far transcend them. In the purely mathematical sciences, abstracted from matter, as geometry and arithmetick, we may vie with them, as also in history; but in astronomy, geography, and chronology, we excel them much. No wonder they should outstrip us in those arts which are conversant in polishing and adorning their language, because they bestowed all their time and pains in cultivating of them, and had but one, and that their native tongue, to mind. But those arts are by wise men censured, as far inferior to the study of things, words being but the pictures of things; and to be wholly occupied about them, is to fall in love with a picture, and neglect the life; and oratory, which is the best of these arts, is but a kind of voluptuary one, like cookery, which sophisticates meats, and cheats the palate, spoiling wholsome viands, and helping unwholsome."

Before resuming our narrative it may be proper to state some particulars respecting the celebrated founder of the British Museum, to whom there has been more than one occasion of alluding in the preceding pages. Sir Hans Sloane was born at Killileagh in Ireland on the 16th April 1660. His father was a Scotchman, who headed a colony which, in the

reign of James I., was planted in the northern part of the sister isle. Having at an early age evinced a decided taste for natural history, he chose the profession of medicine, and after studying four years in London, where he became acquainted with Boyle and Ray, went to Paris, and afterwards to Montpellier, in which latter place he took his degree. At the age of twenty-four he settled in London, and became a Member of the Royal Society. In April 1687, he was made a Fellow of the College of Physicians, and in November following embarked for Jamaica as physician to the Duke of Albemarle, who was appointed governor of the island; but that nobleman having died soon after his arrival, Dr Sloane returned to England after an absence of only fifteen months. In 1693, he was made secretary to the Royal Society, and in the ensuing year named physician to Christ's Hospital; in 1701, he obtained a medical diploma from Oxford, and, in 1708, was elected an Associate of the Academy of Sciences at Paris. In 1716, he was created a baronet by George I., an honour which no medical man had previously obtained, and afterwards was raised to the rank of physician-general to the army. On the accession of George II. he was made physician in ordinary to his Majesty; and on the death of Sir Isaac Newton, in 1727, succeeded that illustrious philosopher in the chair of the Royal Society, which he occupied till 1740, when his advanced age induced him to resign it. He died at Chelsea on the 11th January 1752.

Sir Hans Sloane was a man of the most respectable character, being distinguished not less for his liberality and patriotic zeal, than by his attainments in science. The most important of his works

is the Natural History of Jamaica, of which the first volume appeared in 1707, the second not till 1725. He was a governor of most of the hospitals of the metropolis, to which he left considerable sums. He set on foot the scheme of a dispensary for the poor; gave the Apothecaries' Company a piece of ground for a botanic garden; and on many occasions exerted himself effectually for the public benefit. Such a man is undoubtedly worthy of more honour and admiration than the mere author, who, it may be from the most selfish motives, labours in solitude to enlighten the world and illustrate himself: "The good that men do too often dies with them," and as books are legacies of which the benefit is more extended than that of individual acts of generosity or patriotism, people are ever ready to laud an author, even although they may not clearly see wherein his merit lies; while the truly good, whose lives are a continued scene of beneficence, have but a slight hold on the admiration of posterity. The share which Sir Hans Sloane had in the establishment of the British Museum is the circumstance on which his reputation seems now chiefly to depend. Having made an extensive museum of natural history, medals, books, and manuscripts, he bequeathed it to the public, on condition that £20,000 should be paid to his executors,—a sum far from equal to the value of the collection. In 1753, an act was passed by the legislature for purchasing it and the Harleian manuscripts, as well as for procuring a general repository for their better reception and more convenient use, the Cottonian library included. In this manner commenced the British Museum, which,

by the numerous and extensive additions made to it, has become worthy of the greatest empire of modern times; although, in the department of natural history, it is admitted to be still much inferior to the National Museum of France, and, in several branches of zoology, to be surpassed by many collections in Britain.

Mr Ray, who had now betaken himself to a more sedentary and studious mode of life, began to suffer severely in his health. His Catalogue of English Plants having become scarce, he was solicited by some friends to improve it for a third edition, which he accordingly did; but a difference arising between him and the booksellers, to whom the copyright belonged, he forthwith resolved to publish it in another form. In the mean time, however, to satisfy his friends, he printed his Fasciculus Stirpium Britannicarum, as a substitute for the Catalogue. In 1690, appeared the Synopsis Methodica Stirpium Britannicarum, which may be considered as the most important work on British plants that has been hitherto written, with the exception of Sir James Smith's English Botany, and its continuation by Dr Hooker. It was farther augmented by him, and reprinted in 1696, together with a description of the Cryptogamic plants, which had hitherto received little attention.

Having thus published many important works on natural history, he resolved to compose another in which he should unite that science with his proper profession of divinity, and accordingly commenced his Demonstration of the Being and Attributes of the Deity,—a performance on which his popular fame now principally rests. When finished he trans-

mitted it, in March 1690, to his friend Dr Tancred Robinson, who disposed of it agreeably to his directions; so that it made its appearance in the following year. One of his reasons for writing this admirable treatise he expresses in the following words:—"By virtue of my function I suspect myself to be obliged to write something in divinity, having written so much on other subjects; for being not permitted to serve the church with my tongue in preaching, I know not but it may be my duty to serve it with my hand by writing; and I have made choice of this subject, as thinking myself best qualified to treat of it. If what I have now written," he continues, "shall find so favourable acceptance as to encourage me to proceed, God granting life and health, the reader may expect more; if otherwise, I must be content to be laid aside as useless, and satisfy myself in having made this experiment."

The objects of this work, which is entitled The Wisdom of God manifested in the Works of the Creation, were, 1*st*, To demonstrate the existence of a Deity; 2*dly*, To illustrate some of his principal attributes; 3*dly*, "To stir up and increase in us the affections and habits of admiration, humility, and gratitude." Like many excellent theological treatises of former times, it is now less frequently read than it deserves to be. Happily, however, we have volumes of more recent date, which inculcate the same principles, with perhaps more accuracy of detail in all that relates to science. From a passage in it we learn what was his conception of the true character of a naturalist: "Let it not suffice us," says he, "to be book-learned, to read what others have written, and to take upon trust more falsehood than

truth. But let us ourselves examine things as we have opportunity, and converse with nature as well as books. Let us endeavour to promote and increase this knowledge, and make new discoveries, not so much distrusting our own parts, or despairing of our own abilities, as to think that our industry can add nothing to the invention of our ancestors, or correct any of their mistakes. Let us not think that the bounds of science are fixed like Hercules' pillars, and inscribed with a *ne plus ultra*. Let us not think we have done when we have learnt what they have delivered to us. The treasures of nature are inexhaustible. Here is employment enough for the vastest parts, the most indefatigable industries, the happiest opportunities, the most prolix and undisturbed vacancies."

As a specimen of the author's manner and reasoning, we may present a passage in which he refutes the opinion of Descartes, that it were an absurd and childish thing, and a resembling of God to a proud man, to assert, that he had made the world, and all the creatures in it, for his own honour. "It is most reasonable that God Almighty should intend his own glory: For he being infinite in all excellencies and perfections, and independent upon any other being, nothing can be said or thought of him too great, and which he may not justly challenge as his due; nay, he cannot think too highly of himself, his other attributes being adequate to his understanding; so that, though his understanding be infinite, yet he understands no more than his power can effect, because that is infinite also. And, therefore, it is fit and reasonable, that he should own and accept the creatures' acknowledgments and ce-

lebrations of those virtues and perfections, which he hath not received of any other, but possesseth eternally and originally of himself. And, indeed (with reverence be it spoken), what else can we imagine the ever-blessed Deity to delight and take complacency in for ever, but his own infinite excellencies and perfections, and the manifestations and effects of them, the works of the creation, and the sacrifices of praise and thanks offered up by such of his creatures as are capable of considering those works, and discerning the traces and footsteps of his power and wisdom appearing in the formation of them; and, moreover, whose bounden duty it is so to do. The reason why man ought not to admire himself, or seek his own glory, is, because he is a dependent creature, and hath nothing but what he hath received; and not only dependent, but imperfect; yea, weak and impotent: And yet I do not take humility in man to consist in disowning or denying any gift or ability that is in him, but in a just valuation of such gifts and endowments, yet rather thinking too meanly than too highly of them; because human nature is so apt to err in running into the other extreme, to flatter itself, and to accept those praises that are not due to it; pride being an elation of spirit upon false grounds, or a desire and acceptance of undue honour. Otherwise, I do not see why a man may not admit, and accept the testimonies of others, concerning any perfection, accomplishment, or skill, that he is really possessed of; yet can he not think of himself to deserve any praise or honour for it, because both the power and the habit are the gift of God: And considering that one virtue is counterbalanced by many vices, and

one skill or perfection with much ignorance and infirmity."

This book obtaining general approbation, the impression, which consisted of 500 copies, was quickly sold off. A new edition was therefore published, and several others succeeded. Encouraged by this success, he prepared for the press his Three Physico-theological Discourses, concerning the Chaos, Deluge, and Dissolution of the World, the substance of which had been embodied in some sermons which he preached before the university. This work has also gone through several editions. In the opinion of the illustrious Cuvier, it affords "a system of geology as plausible as any of those which had appeared at this period, or for a long time afterwards;" and if it contain facts and arguments which are not now admitted as accurate or conclusive, this, with our experience of like defects in other theories, should teach us to moderate our zeal in defending any hypothesis elicited from the partial examination of that complex system, which, being the work of infinite power and wisdom, cannot be thoroughly understood by minds constituted like ours.

In one of these works is an estimate of the number of animals and plants known in Ray's time, to which it is of importance that we should advert, as it furnishes an interesting fact in the history of science. According to the author's classification, animate bodies are divided into four orders, "beasts, birds, fishes, and insects." The number of *beasts*, including also *serpents*, that had been accurately described, he estimates at not above 150, adding that, according to his belief, "not many, that are of

any considerable bigness, in the known regions of the world, have escaped the cognizance of the curious." At the present day, more than 1000 species have been described. The number of *birds*, he says, "may be near 500; and the number of *fishes*, secluding shell-fish, as many: but, if the *shell-fish* be taken in, more than six times the number." As to the species remaining undiscovered, he supposes "the whole sum of beasts and birds to exceed by a third part, and fishes by one-half, those known." The number of *insects*, that is, of animals not included in the above classes, he estimates at 2000 in Britain alone, and 20,000 in the whole world. The number of *plants* described in Bauhin's Pinax was 6000, and our author supposes, that "there are in the world more than triple that number; there being in the vast continent of America as great a variety of species as with us, and yet but few common to Europe, or perhaps Africk and Asia. And if," says he, "on the other side the equator, there be much land still remaining undiscovered, as probably there may, we must suppose the number of plants to be far greater."—"What," he continues, "can we infer from all this? If the number of creatures be so exceeding great, how great, nay immense, must needs be the power and wisdom of Him who formed them all!"

Early in 1692, the Synopsis Methodica Animalium Quadrupedum et Serpentini Generis was finished, and published the year after. Important as were the botanical writings of Ray, his zoological works have had a more decided influence on the advancement of natural history. "Their peculiar character," says Cuvier, "consists in clearer and stricter methods

than those of any of his predecessors, and applied with more constancy and precision. The divisions which he has introduced into the classes of quadrupeds and birds have been followed by the English naturalists almost to our own day; and we find very evident traces of his system of birds in Linnæus, Brisson, Buffon, and all the authors who have treated of that class of animals." In the Synopsis of Four-footed animals and Serpents, he commences with an interesting discussion respecting the nature and faculties of animals. The definition, however, on which he proceeds is scarcely correct, or at least sufficiently distinctive:—"An animal is an animated body, endowed with sense and spontaneous motion, or rather with the faculty of feeling and moving, although it may not change place." In treating of the generation of the lower species, he discusses the subject of spontaneous or equivocal origin, the idea of which he refutes, and endeavours to prove that all animals were created at one time. The division of them into viviparous and oviparous he rejects, alleging, that all are in one sense or other oviparous. The most suitable primary division, he says, is into *blooded* and *bloodless*, or, as we should say, red-blooded and white-blooded. The former may be divided into those which respire by *lungs*, and those which respire by *gills*. The first of these are again divided into such as have two ventricles to the heart, and such as have only one. Animals with two ventricles are viviparous, as *Quadrupeds* and *Cetacea*, or oviparous, as *Birds*. Those having a heart furnished with a single ventricle, are the *Oviparous Quadrupeds*, and serpents. Animals that respire by gills are the true *Fishes*, not includ-

ing whales. The *white*-blooded animals are divided into the larger and the smaller. The former, he says, are suitably divided by Aristotle into three kinds or orders: 1. *Mollusca;* 2. *Crustacea;* 3. *Testacea.* The smaller white-blooded animals are the *Insects.* The following table exhibits a summary of this classification, which is essentially that of Aristotle:—

Red-blooded Animals.

Respiring by lungs, and having a heart furnished with two ventricles, viviparous, and aquatic,.....CETACEA.
Terrestrial,.....QUADRUPEDS.
Oviparous,.....BIRDS.
Those having a heart with a single ventricle,.....OVIPAROUS QUADRUPEDS AND SERPENTS.
Respiring by gills,.....FISHES.

White-blooded Animals.

Of large size,..... { MALACIA or MOLLUSCA. / MALACOSTRACA or CRUSTACEA. / OSTRACODERMA or TESTACEA.
Of small size,.....INSECTS.

Characterizing the different groups by circumstances connected with their organization, he arranges quadrupeds into those which have undivided hoofs, as the *horse;* those having cleft hoofs, of which some are ruminant, others not. Of the former, some have permanent concave horns, as *oxen, sheep, goats;* others have solid deciduous horns, as *deer.* The cloven-footed animals which do not ruminate are the *hog* family. The rhinoceros, hippopotamus, tapir, and musk, he classes as anomalous. Of the unguiculate animals, some are ruminant, with two claws only, as the *camel;* others are carnivorous, with more numerous claws, as *cats, dogs, polecats.* Some again are herbivorous, with two long front teeth, as *hares;* and others are tooth-

less, as the *anteater*. Other animals of this kind are furnished with wings, and have a short muzzle, as the *bats;* while some are without wings, as the *sloth*. *Tortoises, lizards,* and *serpents,* bring up the rear.

After this work had been published, he completed a Synopsis of Birds and Fishes, which was sent to Dr Robinson to be printed; but the booksellers who had the copyright neglected it, so that it did not appear until after the author's death, when it was enlarged and edited by Derham in 1713.

Having finished these synopses, Mr Ray considered his labours at an end,—a consummation which gave him the more joy, because he had for several years suffered severely in his health. But soon after, he was induced to add to an English translation of Rauwolf's Travels "three Catalogues of such trees, shrubs, and herbs, as grow in the Levant." His next publication was the Catologus Stirpium in Exteris Regionibus Observatarum, consisting of species not growing spontaneously, or at least very rarely seen, in Britain. Having taken occasion in this work to criticize the method of Rivinus, this circumstance gave rise to some literary altercation, the result of which was a more careful revisal of his system, and a republication of his Methodus Plantarum Nova. At this period he was so tormented by a continual diarrhœa and painful ulcers in his legs, which kept him sleepless for whole nights, that he could not walk into the fields, much less visit the botanic gardens, where he might have found materials for his work.

His booksellers being unwilling to incur the pecuniary hazard attending this work, it was transmit-

ted by Mr Ray to his friend Dr Hotton, professor of botany at Leyden, who got it printed in 1703. The Dutch publishers inserted in the titlepage that it was printed at London for Smith and Walford, the persons who usually took charge of his books; and although the author objected to this proceeding they disregarded his wishes, alleging, that "it was customary among the printers to say what they thought would be for their interest in such cases." This production was very favourably received on the Continent, and Hotton used it as his text-book.

In a letter to Dr Derham, written in May 1702, he thus describes his condition:—"It is not many years since I applied myself to the observation and search of insects, in order to compose an history of them; but now I am wholly taken off from that study, by the afflictive pains I almost constantly labour under, by reason of ulcers upon my legs, I having not been half a mile out of my house these four years; and though I have made use of many means, and have had the advice of some of the most skilful surgeons and physicians, yet without success, growing yearly worse and worse. Besides, I have been very much haunted with a troublesome diarrhœa, frequently recurring; so that you may well think I can have but little heart to mind natural history: But I am yet so far engaged, that I cannot shake it off. I have now just ready to go under the press a third volume of the History of Plants, being a supplement to the two former volumes, which hath engrossed almost my whole time for two whole years. Besides, I have a little book now printing at Leyden, in Holland, entitled Methodus Plantarum emendata et aucta."

We now approach the termination of the career of this truly great man, who was distinguished not less for his fervent piety than for his extensive knowledge and unwearied application. The last letter which he wrote was to Sir Hans Sloane, and is as follows :—

"DEAR SIR,—The best of friends. These are to take a final leave of you as to this world. I look upon myself as a dying man. God requite your kindness expressed any ways towards me an hundred-fold,—bless you with a confluence of all good things in this world, and eternal life and happiness hereafter,—grant us an happy meeting in heaven. I am, Sir, eternally yours, JOHN RAY.

"Black Notley, Jan. 7, 1704."

There is a passage in The Wisdom of God manifested in the Works of Creation, which exhibits his ideas of a future state, and which it would be instructive to compare with the maniacal effusions of infidels and scoffers: "It is not likely that eternal life shall be a torpid and inactive state, or that it shall consist only in an uninterrupted and endless act of love; the other faculties shall be employed, as well as the will, in actions suitable to, and perfective of, their natures,—especially the understanding, the supreme faculty of the soul, which chiefly differenceth from brute beasts, and makes us capable of virtue and vice, of rewards and punishments, shall be busied and employed in contemplating the works of God, and observing the divine art and wisdom manifested in the structure and composition of them; and reflecting upon their great

Architect the praise and glory due to him. Then shall we clearly see, to our great satisfaction and admiration, the ends and uses of these things which here were either too subtle for us to penetrate and discover, or too remote and unaccessible for us to come to any distinct view of, viz. the planets and fixed stars, those illustrious bodies, whose contents and inhabitants, whose stores and furniture, we have here so longing a desire to know, as also their mutual subserviency to each other. Now the mind of man being not capable at once to advert to more than one thing, a particular view and examination of such an innumerable number of vast bodies, and the great multitude of species, both of animate and inanimate beings, which each of them contains, will afford matter enough to exercise and employ our minds, I do not say to all eternity, but to many ages, should we do nothing else.

"Let us, then, consider the works of God, and observe the operations of his hands. Let us take notice of, and admire his infinite wisdom and goodness in the formation of them. No creature in this sublunary world is capable of so doing beside man, and yet we are deficient herein. We content ourselves with the knowledge of the tongues, or a little skill in philology, or history perhaps, and antiquity, and neglect that which to me seems more material, I mean natural history and the works of the creation. I do not discommend or derogate from those other studies; I should betray mine own ignorance and weakness should I do so; I only wish they might not altogether justle out and exclude this. I wish that this might be brought in fashion among us. I wish men would be so equal and civil, as not

to disparage, deride, and vilifie those studies which themselves skill not of, or are not conversant in; no knowledge can be more pleasant than this,—none that doth so satisfie and feed the soul; in comparison whereto that of words and phrases seems to me insipid and jejune. That learning (saith a wise and observant prelate) which consists only in the form and pedagogy of arts, or the critical notions upon words and phrases, hath in it this intrinsical imperfection, that it is only so far to be esteemed as it conduceth to the knowledge of things, being in itself but a kind of pedantry, apt to infect a man with such odd humours of pride, and affectation, and curiosity, as will render him unfit for any great employment."

We do not find any particular account of his last years, nor of his family relations and circumstances, further than that he had three daughters, and lived contentedly on very humble means; being constantly occupied, when his health permitted, in studying the works of God, and communicating the results of his observations to the world. We are not aware of a single stain on his character, and are proud to point to him as a naturalist of undoubted and acknowledged powers, who "walked humbly with his God," and furnishes the best practical refutation of the lying assertion advanced by certain philosophers of the "grand nation," that men eminent for piety are either fools or knaves. As he had lived, so he desired to die "in the communion of the Catholick Church of Christ, and a true though unworthy son of the church by law established in this kingdom," of which he considered "the doctrine pure, and the worship decent, and agreeable

to the Word of God." After making this declaration, he desired the Rev. Mr Pyke, rector of Black Notley, to read to him the prayers of the church appointed to be used in the visitation of the sick; and, in particular, the absolution. He then received the sacrament, "which, as it is men's duty often to receive in the time of health, so, at the hour of death," he said, "it was a necessary *viaticum* he thought for the great journey he was now a-going."

He died in his own house, at Black Notley, on the 17th January 1705, having reached the seventy-seventh year of his age, and was buried, according to his own desire, in the church of that parish. The authors of the Biographia Britannica, however, assert that he declined the offer made by the rector, of a place in the chancel, choosing rather to repose with his ancestors in the churchyard. A monument was erected to him at the expense of some of his friends, with an elegant Latin epitaph, descriptive of his character, composed by the Rev. William Coyte, M. A. In 1737, this monument, having fallen into decay, was restored at the charge of Dr Legge, and removed into the church. Forty-five years after, it was repaired by Sir Thomas Gery Cullum and others, who subjoined an additional inscription.

According to his biographer, Dr Derham, he "was a man of excellent natural parts, and had a singular vivacity in his style, whether he wrote in English or Latin. In a word, in his dealings, no man more strictly just; in his conversation, no man more humble, courteous, and affable. Towards God, no man more devout; and towards the poor and distressed, no man more compassionate and charitable,

according to his abilities." His merits have been duly appreciated, both by foreigners and his own countrymen; and although, in the last century, they seemed in danger of falling into oblivion, amid the blaze of the numerous discoveries and improvements then made, they are, at the present day, brought more prominently into view, when men have begun to compare systems, and to shake off the influence of party-spirit. An interesting commemoration of him was made in London on the 29th November 1828. A genus of plants was dedicated to his memory by Plumier, under the name of *Jan Raia*, which Linnæus changed into *Rajania*, and Smith into *Raiana*. *Raia* would have been more appropriate; but unfortunately it was previously occupied by the skate, and therefore could not be allotted to him of whom Sir James Smith says, that he was "the most accurate in observation,—the most philosophical in contemplation,—and the most faithful in description, amongst all the botanists of his own, or perhaps any other time." Several species of fishes, however, are named after him, in consequence of his having been the first who made mention of them.

"Mr Ray," says Dr Pulteney, in his Sketches of the Progress of Botany, "had the singular happiness of devoting fifty years of his life to the cultivation of the sciences he loved. Incited by the most ardent genius, which overcame innumerable difficulties and discouragements, his labours were, in the end, crowned with a success before almost unequalled. He totally reformed the studies of botany and zoology; he raised them to the dignity of a science, and placed them in an advantageous point of view;

and, by his own investigations, added more real improvement to them in England than any of his predecessors. The extent of his improvements in science procured him the admiration of his contemporaries, and have justly transmitted his name to posterity, among those who have done honour to their age and country."

We have now only to present a catalogue of his more important works:—

1. Historia Plantarum Generalis, species hactenus editas aliasque insuper multas noviter inventas et descriptas complectens. Two vols folio. The first was published in 1686; the second, in 1687; and the third, in 1704.

2. Synopsis Methodica Stirpium Britannicarum. The first edition was published in 1690. The second, considerably enlarged, appeared in 1696. The third, printed in 1724, was edited by the celebrated Dillenius. This edition is the one in general use, and is that referred to by Linnæus, Hudson, Smith, and other botanists. The Synopsis was illustrated by Petiver with a set of seventy-two folio plates, having twelve figures in each.

3. Synopsis Methodica Animalium Quadrupedum et Serpentini Generis. 8vo, London, 1693.

4. Synopsis Methodica Avium et Piscium. 8vo, London, 1713. A posthumous work, edited by Dr Derham.

5. Historia Insectorum. 4to, London. Printed at the expense of the Royal Society in 1710.

6. The Wisdom of God manifested in the Works of the Creation, in two parts. London, 1691. There are many editions.

7. Three Physico-Theological Discourses concerning the Chaos, Deluge, and Dissolution of the World.

8. Observations, Topographical, Moral, and Physiological, made in a Journey through Part of the Low Countries, &c. London, 1673. A second edition in 1738.

To these may be added,

9. Francisci Willughbeii Ornithologiæ, Libri tres, with plates. Folio, London, 1676. There is also an edition in English, with three discourses, viz. Of the Art of Fowling, Of the Ordering of Singing Birds, and Of Falconry. London, 1678.

10. Francisci Willughbeii Historia Piscium, Libri quatuor, with plates. Folio, Oxford, 1686.

When this pious writer died, his papers were intrusted to his friend Dr Derham, who, having arranged and selected such as seemed of most importance, published a part of them in 1718, under the name of Philosophical Letters between the late learned Mr Ray and several of his ingenious Correspondents, natives and foreigners, to which are added those of Francis Willughby, Esq. The same person, as has been already mentioned, also edited the Synopsis of Birds and Fishes, and prepared for publication his posthumous work on Insects. He moreover got ready for the press his Travels in England, Wales, and Scotland, to which he intended to prefix an account of the author; but, although the life was written, the book did not make its appearance until a later period, when, as has been noted above, it came forth under the direction of Mr George Scott, bearing the title of the Select Remains of the learned John Ray.

The principal authorities for his life and writings are, the Select Remains just mentioned; Dr Pulteney's Sketches of the Progress of Botany; the article Ray, in Rees' Cyclopædia, by Sir James Edward Smith; and that by Cuvier and Du Petit-Thouars, in the Biographie Universelle. In the two latter, his botanical and zoological labours are carefully recorded; and from the former we learn, in conclusion, that "his hand-writing was peculiarly fair and elegant;" which has been the case with few of the more distinguished naturalists. His portraits are not numerous, but there is one in oil, taken at an advanced period of his life, remaining in the British Museum; a miniature, in the possession of Dr John Sims, having been engraved in the first volume of the Annals of Botany, published in 1805; and two prints, the one by Elder, the other by Vertue, from a picture by Faithorne, being prefixed to the third edition of the Synopsis, and to the Historia Plantarum. We may add that, in the fifteenth number of the Gallery of Portraits, published under the Superintendence of the Society for the Diffusion of Useful Knowledge, is a beautiful engraving by Meyer of the painting in the British Museum.

In the likeness of Ray the phrenologist will look in vain for indications of those intellectual faculties which are displayed in his writings. The forehead is contracted in all its dimensions; so as to form a direct contrast to that of Cuvier, another naturalist of equal industry and zeal, but perhaps of not more comprehensive mind.

REAUMUR.

Account of the Life and Writings of Reaumur.

Birth and Education of Reaumur—He settles at Paris, where he is introduced to the Scientific World by the President Henault, and becomes a Member of the Academy of Sciences—His Labours for the Improvement of the Arts—His Works on Natural History, of which the Memoirs on Insects are the most important—His Occupations and Mode of Life.

René Antoine Ferchault de Reaumur, one of the most ingenious naturalists whom France has produced, was born at Rochelle in 1683. He commenced his studies in his native place, continued them at Poitiers under the Jesuits, and finished his professional course at Bourges; but feeling less inclined to the practice of law than to the investigations of natural science, he resolved to devote himself entirely to the latter. In this respect he was the more justified in following his inclination, that he possessed a fortune sufficient to support him without engaging in any occupation merely to procure the means of subsistence. He began to prepare for his new pursuits by studying mathematics, and when he thought his proficiency such as to qualify him to make a respectable figure among the naturalists and philosophers of the capital, he removed thither in the year 1703.

The President Henault, who held a distinguished station among the literati of Paris, and who was his relative, introduced him to the scientific world. In 1708, when only twenty-four years of age, he presented some geometrical memoirs to the Academy of Sciences, who were so much pleased with his performance as to admit him into their society,—an honour which he enjoyed nearly fifty years. His exertions were directed successively to the improvement of the arts, to natural philosophy, and to natural history. From his entrance into the academy he scarcely allowed a year to pass without publishing some work of importance. Soon after his admission he was appointed to assist in drawing up a description of certain arts and trades; but not confining himself to a simple elucidation, he endeavoured also to improve them, by applying the principles of physics and chemistry. On the other hand, by observing the ingenious combinations employed in some of the arts, he had frequent opportunities of adding to his knowledge of the phenomena of nature.

In his inquiries into the business of ropemaking, for example, he proved by conclusive experiments that, contrary to the common opinion, twisting impairs the strength of ropes. Again, while describing the labours of the goldbeater, he took occasion to show the prodigious ductility possessed by certain substances. But, more especially, when examining the processes by which artificial pearls are coloured, he discovered the singular matter which gives lustre to the scales of fishes, and even explained the formation and growth of those scales. The colouring principle in glass pearls is obtained from the bleak (*Cyprinus alburnus*), an

inhabitant of fresh water, and about six inches in length. This silvery ingredient is procured by macerating its scales in water, and is then mixed with a little isinglass. The small globes which are to represent pearls are first furnished with an internal coating of the solution, and then filled with melted wax to give them suitable weight. The pearly matter occurs also in the membrane which envelopes the stomach and intestines, and is supposed by Reaumur to be produced in the latter, from which it is conveyed by the blood-vessels to the scales. He likewise made inquiries into the formation and growth of shells, which he proved to be developed by accessions to their outer edge. He is even said to have examined the structure of pearls, with the view of forcing the shell-fish to produce them. When describing the turquoise-mines of the south of France, and the means adopted to make the mineral assume a blue colour, he discovered that these alleged stones were the teeth of a large animal, which is now known under the name of the mastodon.

His most important labours, however, with reference to the arts, were his researches respecting iron and steel, which he published in 1722, in a separate work under the title of Traité sur l'art de convertir le fer en acier, et d'adoucir le fer fondu. At this period all the steel that was used in France was imported, none having previously been made in that country; and one may imagine how numerous and patient were the trials made by Reaumur before he succeeded in his object. The Duke of Orleans rewarded him for this valuable discovery, by bestowing on him a pension of 12,000 livres. In like

manner, he found out the method of manufacturing tin-plate or whiteiron, which until then had been brought from Germany. In his various experiments, he had frequent occasion to observe that melted metals assume regular forms on cooling, and he accordingly gave an account of the crystallizations which they present. The manufacture of porcelain also engaged his attention, and received considerable improvements from him, although he did not succeed in perfecting it. In 1739, he made known a method which he had discovered of giving a whiteness and opacity to glass, which causes it to assume the appearance of chinaware. He was also the first who tried in France the expedient practised by the Egyptians for hatching eggs,—a subject which, being of a nature suited to popular apprehension, procured for him at least as much estimation as all his other researches.

In Great Britain his fame seems to rest almost entirely on his peculiar scheme of graduating the thermometer. He chose the extreme points of the freezing and boiling of water, which, under similar circumstances, are always fixed and unvarying. The interval between these points he divided into eighty degrees, upon the principle that spirit of wine, in a certain state of rectification, expands 80,000 parts. In his experiments on this subject he arrived at some valuable conclusions, in regard to the varieties in their volume and temperature which are exhibited by particular fluids when combined, as well as on frigorific mixtures. He also carefully collected the observations on heat made in different places by means of his thermometer.

The importance and utility of these researches

are unquestionable, and yet there is even more of novelty and interest in those which he made in natural history. For instance, he explained the means by which many shells, sea-stars, and other mollusca or zoophytes, execute their progressive motion. He likewise illustrated the curious manner in which the claws of crabs and lobsters are reproduced. He also threw a new light on the singular action of the torpedo, and the organ by means of which it is exercised, although the phenomena of electricity were not then sufficiently understood to enable him to perceive all the relations of his subject. In 1718, he published a memoir on the rivers of France, which contain grains of gold in their sands, and soon after described the immense beds of fossil shells known in Touraine under the name of *falun*. In 1723, he made observations on the lustre emitted by several kinds of shell-fish, especially the pholades, which perforate wood and stones.

Physiology is indebted to him for the ingenious and decisive experiments which, in 1752, made known the difference that exists, with respect to digestion, between birds of prey, whose stomach acts on their food only by means of a solvent fluid, and granivorous birds, in which a very powerful muscular gizzard exercises a pressure sufficient to break down the hardest bodies and reduce them to powder.

These labours might well have sufficed for a single life; but the most remarkable undertaking of Reaumur has not yet been mentioned. It is entitled Memoires pour servir à l'Histoire des Insectes, and extends to six quarto volumes, which

were published between 1734 and 1742. This work occupied many years, and was the result of numerous observations made principally in his own garden, where he kept insects of all kinds, for the purpose of examining their habits, changes, and generation. It is, however, incomplete,—the locusts and grashoppers, as well as the whole tribe of coleóptera, having been intended for subsequent volumes, which never appeared.

In regard to these Memoires, he remarks, that although he has endeavoured to give them some degree of connexion, they might for the most part be considered as independent of each other; and that his object was not to present a systematic description of insects, but to furnish materials for the use of future naturalists. It is therefore improper to say, that he wrote his work with an entire contempt of method; and certainly the notices which he collected must have required more time and talent than the mere arrangement of insects according to characters derived from their external form. "The number of observations necessary for a tolerably complete history of so many minute animals," he says, "is prodigious. When one reflects on all that an accomplished botanist ought to know, it is enough to frighten him. His memory is loaded with the names of twelve or thirteen thousand plants, and he is expected to be able to recall on occasion the image of any one of them. There is perhaps none of these plants that has not insects peculiar to itself; and some trees, such as the oak, give sustenance to several hundreds of different species. And, after all, how many are there that do not live

on plants! How many species that devour others! How many that live at the expense of larger animals, on which they feed continually! How many species are there, some of which pass the greater part of their time in water, while others pass it entirely there! The immensity of Nature's works is nowhere more apparent than in the prodigious multiplicity of these species of little animals." He then proceeds to remark, that, as it is impossible for one man to acquire a knowledge of all the insects of even a limited district, and as thousands of minute insects must for ever remain unknown to us, instead of burdening our memory with the characteristic distinctions of these creatures, and thus preventing ourselves from attending to matters of more importance, it would be sufficient for us to know the principal genera, and especially those that are of most frequent occurrence, and to make ourselves acquainted with their peculiarities, their food, their propagation, the different forms which they assume in the course of their life, and such like circumstances. He avows that he had no great regard for a precise enumeration of the species of each genus; holding it enough to distinguish the more remarkable.

"Although," he continues, "we would greatly restrict the limits of the study, there are persons who will think them still too wide; there are even some who consider all knowledge of this part of natural history as useless, and who unhesitatingly pronounce it a frivolous amusement. We are equally willing that these pursuits should be regarded as amusements, that is, as studies which, so far from being trouble-

some, afford pleasure to the person who engages in them. They do more,—they necessarily raise the mind to admire the Author of so many wonders. Ought we to be ashamed of ranking among our occupations observations and researches, of which the object is an acquaintance with the works on which the Supreme Being has displayed a boundless wisdom, and varied to such a degree? Natural history is the history of his works; nor is there any demonstration of his existence more intelligible to all men than that which it furnishes."

The two first volumes treat of caterpillars, their forms and habits, their metamorphoses into butterflies, and the insects which attack them, or which live within their bodies. The third speaks of the small creatures named moths, which exist in the interior of the substances which they devour, or form of them coverings for their protection. It also contains the history of the aphides, a very numerous race of small insects, which suck the juices of trees and plants, live in society, and are often productive of great damage. These animalcules are especially remarkable for their mode of generation; it having been proved by M. Bonnet, that a single impregnation is sufficient for the production of many successive generations, and that they are viviparous in summer and oviparous in autumn. The flies which produce the excrescences named gall-nuts, and the worms from which come the dipterous insects, so diversified in their forms, manners, and places of abode, occupy the fourth volume. The fifth contains, among other genera, the bees, of which the history is so singular and interesting.

Certain varieties of these as well as wasps are described in the last volume. Similar researches were made by Bonnet and De Geer, of whom we shall have occasion to speak in another part of our series.

Reaumur was the first naturalist who formed an extensive collection of animals in France. The celebrated Brisson, who was the keeper of his museum, derived from it the principal materials for his works on quadrupeds and birds. These last afterwards constituted the basis of the Royal Museum at Paris.

When the first volumes of Buffon made their appearance, the elegance of their style had a prejudicial effect on the popularity of Reaumur's writings; and as naturalists, like poets and artists, generally belong to the *irritabile genus*,—the sensitive class of mankind,—our author seems to have experienced considerable chagrin. In other respects, however, he lived a very quiet life; residing sometimes on his estate in Saintonge, and sometimes at his country-house of Bercy, in the neighbourhood of Paris. He had no public employment, except that of intendant of the order of St Louis, of which he performed the duties for the benefit of a relative whom circumstances prevented from discharging them, and to whom he resigned the emoluments. He died on the 18th October 1757, at the age of 74; his death being accelerated by a fall which he had received at the castle of Bermondière, whither he had gone to pass the vacations. He seems to have been in all respects an amiable man, of correct habits and great mildness of disposition. His life, therefore, presents none of those bickerings and other mani-

festations of rivalry which have produced so much disquietude to some other naturalists; and, as his fortune was sufficient for his comfortable subsistence, he was freed from those cares which distract the attention, and enabled to pursue his favourite studies with advantage.*

* Biographie Universelle, art. Reaumur, tome xxxvii. p. 198.

LINNÆUS.

SECTION I.

Birth and Education of Linnæus.

Birth and Parentage of Linnæus—He is destined for the Clerical Profession—His early Fondness for Plants—He is sent to School, where his Progress is so slow that his Father resolves to make him a Shoemaker—Is rescued from this Fate by Dr Rothmann, who receives him into his Family—He becomes decidedly attached to the Study of Nature, enters the University of Lund, and is patronised by Professor Stobæus—When on an Excursion is attacked by a dangerous Malady—Stobæus surprises him in his nocturnal Studies—He goes to Upsal—Is reduced to extreme Poverty, from which he is relieved by Professor Celsius, whom he assists—Is next patronised by Rudbeck, and delegated to read his Lectures—Forms a Friendship with Artedi.

CHARLES LINNÆUS was born on the 23d May 1707, at Rashult, in the province of Smaland. His father, Nils, whose ancestors were peasants, was pastor of the village, and being the first learned man of his house, had, agreeably to a custom prevalent in Sweden, changed his family-name with his profession, and borrowed that of Linné from a large linden-tree, which stood in the vicinity of his native place, between Tomsboda and Linnhult. His mother, Christina Broderson, was the daughter of his father's predecessor in office.

The pious parents had intended him likewise for the service of the church, either because they considered the clerical profession the best adapted to

their son, or as calculated to ensure the means of a comfortable subsistence, and to render him the stay of their old age. But, whatever were their motives, the design, fortunately for the progress of natural science, was frustrated by the propensities which he soon displayed; for, inheriting a strong passion for flowers, he devoted a great part of his earlier years to the cultivation of a corner of the family-garden, which he profusely stocked with wild plants collected in the woods and fields. The excursions which he was thus induced to make, gradually led him to an acquaintance with the productions of the vegetable and animal kingdoms, and were at first rather encouraged than discountenanced by his parents, as affording innocent amusement, and being beneficial to health.

Charles was happy also in the affectionate care of his father, who taught him the elements of the Latin language, geography, and other departments of knowledge suited to his capacity. At the age of seven, however, he was committed to the care of a teacher ill qualified for the task; and three years after he was sent to a grammar-school in the neighbouring town of Wexio, where he continued several years. During this period he made little proficiency in the studies connected with his intended profession; for the love of nature prevailed in his mind to such a degree as to induce him to consider every other occupation as compulsory. He found much more pleasure in gathering plants and insects than in performing the tasks imposed by his teachers. Every hour of respite from his lessons was devoted to his favourite occupation, and all his holidays were spent in rambling over the country. His school-

fellows considered him as an idle vagabond; but his master, whose name was Lanaerius, formed a proper judgment of his genius, which he was the better enabled to do, as he himself was fond of botany.

In 1724, young Linnæus entered the upper college or gymnasium at Wexio, where his deficiencies in classical attainments were looked upon with less indulgence. The admonitions of his teachers were contemned; the passion inspired by nature still prevailed; and complaints were made to his father, who, finding him averse to the study of divinity, and perhaps believing him incapable of acquiring literary knowledge, resolved to bind him apprentice to a shoemaker. Considering the circumstances of his parents, and the little prospect of their son's obtaining a comfortable livelihood by his botanical pursuits, we need not ascribe this determination to a less estimable motive than prudent affection. Fortunately, however, the design was not carried into effect.

A physician at Wexio, who was also professor of medicine in the college of that city, had taken notice of the genius and peculiar pursuits of the boy, and, hearing of his father's intentions, ventured to offer his assistance and advice. The encomiums of this benevolent person, Dr John Rothmann, inspired the parents with unexpected pleasure. The entreaties of their son himself were joined to the kind intercession of his protector, who had promised to take him into his own family for a year, and provide him with every thing necessary. Natural history was not then in Sweden, any more than it is now in our own country, a study which of itself could lead to

wealth, or even to a moderate independence. It was therefore resolved that he should qualify himself for the practice of medicine; and to this proposal the pastor and his wife at length reluctantly assented.

Baffled in their views with respect to Charles, they resolved to transfer their cares to their second son, Samuel, whom they hoped to prevent from addicting himself to similar pursuits by prohibiting his entrance into the garden, and even the gathering of flowers in the fields. This restriction, however, had not the full effect; for Samuel also was a lover of botany, although his parents had the gratification of seeing him at length become a preacher.

In the house of Rothmann, the elder brother, who had hitherto studied botany without any regular method, found Tournefort's Institutiones Rei Herbariæ,—a work which opened new prospects to his view, and tended to increase his zeal. The more he became acquainted with nature, the more did his love of knowledge increase, and his frequent excursions into the country soon rendered his acquirements conspicuous. Having remained three years at the College of Wexio, he was prepared to become a pupil in a higher seminary of learning, and in 1727 set out for the University of Lund.

At an early stage of his progress he had studied several botanical works which are now little known, such as those of Manson, Tilland, Palmberg, Bromellius, and Rudbeck. But the benevolent Rothmann showed him that the guides whom he had followed were unworthy of confidence, and advised him to begin by examining the flower, as recommended by Tournefort, giving him at the same time Valentini's figures of plants. He accordingly

copied these engravings, and commenced a rigorous examination of flowers and fruits. Towards the end of his twentieth year, he attempted to arrange in systematic order the various species growing in the neighbourhood of Wexio and Stenbrohult, many of which he found it difficult to determine, owing to the imperfect manner in which they had been described. Down to this period he had not distinguished himself in any other way than as a young man who was supposed to be foolishly addicted to the study of natural objects, while he ought to have been engaged in more important pursuits; although he says he had always been among the first in mathematics and natural philosophy.

On leaving the gymnasium at Wexio, the rector, Nicolas Krok, gave him a certificate expressed in the following terms:—"Students may be compared to the trees of a nursery. Often among the young plants are found some which, notwithstanding the care that has been bestowed upon them, resemble wild shoots; but, if transplanted at a later period, they change their nature, and sometimes bear delicious fruit. With this hope only I send this young man to the university, where another climate may perhaps prove favourable to his progress." This testimonial, however, he did not find it necessary to show; for he was introduced to the rector by one of his old teachers, Gabriel Hoek, whom he fortunately met at Lund.

Professor Humærus, who was his relative, had promised to support him at this university; but, on arriving, Linnæus was informed that the last duty had just been paid to his remains. He became a pupil of Kilian Stobæus, professor of medi-

cine and botany, whose notice he soon attracted by his diligence and attention, and who, learning his indigent condition, received him into his family. Here he found a small collection of natural objects, which he studied with great delight. At the same time he began to form an herbarium for himself; to add to which he made excursions into the neighbouring districts.

On one of these expeditions he was, or imagined himself to have been, stung by a venomous worm, said to be not uncommon in some parts of Sweden. However this may be, he was seized with a violent disorder, which threatened the extinction of life, more especially as he had removed far into the country, where medical assistance could not be readily procured. This accident, instead of diminishing his zeal, tended to increase his desire of becoming more acquainted with the lower orders of animals. In a work which he subsequently published, this singular worm, the existence of which, however, is still doubtful, is thus described by him:—"It occurs in the extensive turfy marshes of Bothnia, in the northern parts of Sweden. Falling from the atmosphere, frequently upon the bodies of men and animals, it instantly penetrates them with the most intense pain, so as to produce death from agony within a quarter of an hour. I myself was smitten by it at Lund, in 1728. I have not seen the animal unless in a dried state. It seems in its properties to be allied to the chaotic animals. By what means it rises into the air, whence it falls during the interval between the summer and winter solstice, no one has explained."

Stobæus's library was well stored with works on

botany, which Linnæus procured secretly from a young man who also lodged in the house, and in perusing which he often spent a great part of the night. His patron was informed of his vigils, and as he was of a merry, convivial disposition, suspected him of sitting up for the purpose of amusing himself with the servants. He resolved, therefore, to watch his proceedings, and, if his suspicions proved just, to reprimand him for his unbecoming conduct. But on entering Linnæus's room unexpectedly, what was his surprise to find him intrenched among the tomes of Cæsalpinus, Bauhin, Tournefort, and other eminent botanists! The result of this visit, as might have been expected, was free permission to make use of the library, and an increased attachment to the student. The same benevolent person embraced every opportunity of aiding him in his pursuits; gave him lessons on petrifactions and molluscous animals; taught him various branches of medicine; admitted him to his table; sent him occasionally to visit his patients; and went so far as to talk of making him his heir.

In 1728, after he had recovered from the effects of the severe malady with which he had been attacked, he visited his parents. His mother was extremely grieved at seeing him occupy his whole time in collecting plants and glueing them upon paper, as she plainly perceived that there was now no hope of his ever becoming a preacher. Dr Rothmann, who frequently saw him, pointed out the superior advantages which students possessed at Upsal, where there were "the learned Roberg, the great Rudbeck," a splendid library, and a fine botanic garden. He also named many poor students,

who had received assistance from the government, and had become able practitioners. The young naturalist readily believed the representations of one who had taken so much interest in him, and resolved to follow his advice. At setting out, his father gave him a sum of money equivalent to about £8 sterling; informing him at the same time that he could do no more for him.

With this slender provision Charles proceeded to the University of Upsal, where, although he had no reason to expect a kind reception, he hoped at least to obtain more ample means of scientific research. The professors, however, were not such as they had been represented, nor did any of them show the smallest attention to the poor student. Before he had been a year there his pecuniary resources failed; so that he was in a manner cast upon the charity of his companions, among whom he was glad to accept an occasional meal, and even a worn-out article of clothing. The old shoes which they gave him, he was often obliged to mend with pasteboard and birch-bark before he could render them tolerably efficient. He now found reason to sigh for the comfortable home which he had left at Lund; but to it he could not return, for as he had quitted his benefactor Stobæus abruptly, and without so much as apprizing him of his intentions, he justly dreaded his displeasure. Aware that he could not obtain aid from his father, destitute of friends, and even of the hope of procuring a livelihood by the exertion of his talents, he was reduced to the extremity of indigence: yet he despaired not; nature had at all times charms to support his spirits; he struggled with his fate and conquered. On an important

occasion which occurred many years after, he publicly returned thanks to Providence for having supported him amid these privations:—"I thank thee, Almighty God," said he, "that in the course of my life, amidst the heavy pressure of poverty, and in all my other trials, thou hast been always present to me with thine omnipotent aid."

At this period, Olaus Celsius, first professor of divinity, whom Linnæus afterwards, in a letter to Haller, describes as the only botanist in Sweden, returned from Stockholm, where he had been on official business, and happening to visit the college-garden, met a young man, who attracted his notice by the accurate knowledge of plants which he displayed. On inquiring after him, and receiving a satisfactory account of his character and conduct, he gave him an apartment in his house, and supplied him with every thing of which he stood in need. Thus was he on many occasions obliged, if not to solicit, at least to accept pecuniary assistance. He, however, repaid in some measure the kindness of the venerable Celsius, by assisting him in preparing his *Hierobotanicon*, in which the vegetable productions mentioned in Scripture are described. To enable him to perform his task, he was allowed the free use of a library rich in botanical works.

Hitherto Tournefort was the only author to whose works Linnæus was indebted for the more solid parts of his knowledge; but a small book of Vaillant on the structure of flowers now coming into his hands, he perceived many defects in the system he had embraced; and from the ingenious observations made by the latter writer on the sexes of plants, he conceived the idea of founding a system of botany on

the stamens and pistils. With this object in view, he recommenced his studies on a new plan; the sexual distinction continually occupied his thoughts, and the knowledge which he acquired in this path became the basis of his future eminence. A small treatise which he composed on the subject of an academical disputation attracted the notice of Rudbeck, the second of the name, then professor of botany, who, being advanced in years, was looking out for an assistant. He received the ardent student into his house, and delegated to him the office of reading his lectures, and demonstrating the plants in the botanic garden. Rudbeck was also a zoologist, and had made a collection of all the Swedish birds; the examination of which failed not to add to Linnæus's knowledge in this department of natural history. Botany, however, continued to be his favourite study; and about this period he wrote several treatises, which were afterwards published in Holland.

During his residence at Upsal, he had the happiness to enjoy the friendship of a young man, not less fervently devoted than himself to the study of nature. This was Peter Artedi, so well known for his work on fishes. The name of Linnæus is usually mentioned as that of a distinguished botanist; but it ought to be observed, however great his merits were in that capacity, they were scarcely less in the department of zoology, and that from the commencement of his career he manifested nearly as strong a liking to the one as to the other. Speaking of his friendship for Artedi, he says, "He excelled me in chemistry, and I outdid him in the knowledge of birds and insects, and in botany."

At this period, a new prospect opened to his ambi-

tion. A society had been instituted at Upsal, chiefly for the purpose of examining the natural productions of the kingdom. The remote and desert regions of Lapland were less known than any other of the Swedish provinces, although Rudbeck the elder had been sent by Charles XI. to explore them. The curiosities which he brought home had been destroyed by the great fire in 1702; and it was now proposed to repair the loss by sending out another scientific traveller. The choice fell on Linnæus, who was recommended by Celsius and the younger Rudbeck.

SECTION II.

Journey to Lapland.

Linnæus, chosen by the Royal Society of Upsal to travel in Lapland, sets out in May 1732—Enters Lycksele Lapland—A Lapland Beauty—Beds made of Hair-moss—Conversation of a Curate and a Schoolmaster—The Lapland Alps—Their Vegetation—Brief Account of the Rein-deer—Passing over the alpine Region, he enters Norway—Again visits the mountainous Region—Difficulties of the Journey—Pearl-fishery—Forests set on Fire by Lightning—At Lulea he discovers the Cause of an epidemic Distemper among the Cattle—Returns through East Bothland—Concluding Remarks.

HAVING received this appointment, he visited his friend Stobæus at Lund, as also his parents, who were now reconciled to him, and returned to Upsal to prepare for his perilous enterprise.

On the 12th May 1732, he set out alone, equipped as follows:—"My clothes," says he, in his Lachesis Lapponica, "consisted of a light coat of West Gothland linsey-woolsey cloth without folds, lined with red shalloon, having small cuffs and collar of shag; leather breeches; a round wig; a green leather cap, and a pair of half-boots. I carried a small leather bag, half an ell in length, but somewhat less in breadth, furnished on one side with hooks and eyes, so that it could be opened and shut at pleasure. This bag contained one shirt; two pair of false sleeves; two half-shirts; an inkstand, pencase, microscope, and spying-glass; a gauze cap to protect me occasionally from the gnats; a comb; my journal, and a parcel of paper stitched

together for drying plants, both in folio; my manuscript Ornithology, Flora Uplandica, and Characteres Generici. I wore a hanger at my side, and carried a small fowling-piece, as well as an octangular stick, graduated for the purpose of measuring. My pocket-book contained a passport from the Governor of Upsal, and a recommendation from the Academy."

Nature wore her most delightful aspect; the dandelion, the violet, and the primrose, unfolded their blossoms to the sun; the sky-lark chanted its lively song as it soared aloft in the clear sky; and the redwing warbled its love-notes from the lofty pines. How delightful must have been the feelings of the young naturalist, as he advanced toward the scene of those anticipated discoveries, which were to immortalize his name, or at least to increase the sphere of his ideas, and perhaps form the basis of his fortune! As he advanced, "the redwing, the cuckoo, the black-grous, and the mountain-finch, with their various notes, made a concert in the forest, to which the lowing herds of cattle under the shade of the trees formed a bass."

He proceeded through Helsingland, Angermanland, and West Bothland, to Lycksele Lapland, where he embarked on a large river, during his voyage on which he was gratified by the sight of numerous birds. But a succession of cataracts occurring soon after, the owner of the boat, inverting its position, placed it on his head, and "scampered away over hills and valleys, so that the devil himself could not have overtaken him."

By the beginning of June he found himself among swamps, torrents, and woods, occasionally accompanied by a Laplander as guide, and now and

then incurring dangers which would have damped the ardour of a less enthusiastic traveller. On one of these occasions, after wandering a long time in a labyrinth of marshes, he was met by a woman, whom he describes as presenting a very extraordinary appearance: "Her stature was very diminutive; her face of the darkest brown, from the effects of smoke; her eyes dark and sparkling; her eyebrows black; her pitchy-coloured hair hung loose about her head, and on it she wore a flat red cap. 'O thou poor man!' quoth she, 'what hard destiny can have brought thee hither, to a place never visited by any one before? This is the first time I ever beheld a stranger. Thou miserable creature! how didst thou come, and whither wilt thou go?'" Linnæus entreated her to point out some way by which he might continue his journey. "'Nay, man,' said she, 'thou hast only to go the same way back again; for the river overflows so much, it is not possible for thee to proceed further in this direction. From us thou hast no assistance to expect in the prosecution of thy journey, as my husband, who might have helped thee, is ill.'" The traveller begged of her something to eat, and after much difficulty procured a small cheese. He was obliged to retrace his steps through the marshes; and, when almost exhausted by hunger and fatigue, at length reached the house of a poor curate, where his wants were supplied.

The bountiful provision of nature, he remarks, is evinced in providing mankind with bed and bedding, even in this savage wilderness. The great hair-moss (*Polytrichum commune*), called by the Laplanders *romsi*, grows copiously in their damp

forests, and is used for this purpose. They choose the starry-headed plants, out of the tufts of which they cut a surface as large as they please for a bed or bolster, separating it from the earth beneath; and, although the shoots are scarcely branched, they are, nevertheless, so entangled at the roots as not to be separable from each other. This mossy cushion is very soft and elastic, not growing hard by pressure; and if a similar portion of it be made to serve as a coverlet, nothing can be more warm and comfortable. They fold this bed together, tying it up into a roll that may be grasped by a man's arms, which, if necessary, they carry with them to the place where they mean to sleep the following night. If it becomes too dry and compressed, its former elasticity is restored by a little moisture.

Leaving the town of Lulea, on the 25th June, he embarked on the river, which he continued to navigate for several days and nights in a comfortable boat. At a place called Quickjock he was presented by the "famous wife of the curate, Mr Grot," with provisions sufficient to last a week. At Jockmock, the schoolmaster and the priest tormented him "with their consummate and most pertinacious ignorance." The latter began his conversation with remarks on the clouds, showing how they strike the mountains in their passage over the country, carrying off stones, trees, and cattle. "I ventured," says Linnæus, "to suggest that such accidents were rather to be attributed to the force of the wind, for that the clouds could not of themselves lift or carry away any thing. He laughed at me, saying, surely I had never seen any clouds. I replied, that whenever the weather is foggy I walk in clouds, and

when the fog is condensed, and no longer supported in the air, it immediately rains. To all such reasoning, being above his comprehension, he only returned a sardonic smile. Still less was he satisfied with my explanation how watery bubbles may be lifted up into the air, as he told me the clouds were solid bodies. On my denying this, he reinforced his assertion with a text of Scripture, silencing me by authority, and then laughing at my ignorance. He next condescended to inform me, that after rain a phlegm is always to be found on the mountains, where the clouds have touched them. Upon my replying that this phlegm is a vegetable called nostoc, I was, like St Paul, judged to be mad, and that too much learning had turned my brain.

"The other, the pedagogue, lamented that people should bestow so much attention upon temporal vanities, and consequently, alas! neglect their spiritual good; and he remarked that many a one had been ruined by too great application to study. Both these wise men concurred in one thing: They could not conceal their wonder that the Royal Academy should have expressly appointed a mere student for the purposes on which I was sent, without considering that there were already as competent individuals resident in the country, who would have undertaken the business. They declared they would either of them have been ready to accept the charge. In my opinion, however, they would but have exhibited a fresh illustration of the proverb of the ass and the lyre."

On the 1st July, the traveller obtained a glimpse of the Lapland Alps, which resembled a range

of white clouds rising from the horizon. Arriving in the evening at a place named Riomitis, he saw the sun set apparently on the summit of a high mountain,—a spectacle which, although common enough in hilly countries, was so new to him as to excite his utmost surprise, and to induce him to exclaim, "O Lord, how wonderful are thy works!"

Towards the close of day, July 6, accompanied by a native, who acted as his servant and interpreter, he ascended the heights of Wallavari, the first of the range. Here he found himself as in a new world. The forests had disappeared; mountains upon mountains, covered with snow, presented themselves on all sides; no traces of human habitations were to be seen; the plants of the lower districts had ceased, and a vegetation of a peculiar kind occupied their place, presenting such a profusion of new forms to the delighted eye of the naturalist, that he was overcome with astonishment. He observed the silken-leaved alpine lady's-mantle, the deep-green sibbaldia, the little purple-flowered azalea, the diapensia lapponica, the beautiful saxifraga stellaris, rivularis, and oppositifolia, the succulent rose-root, the red lychnis, several ranunculi, and a variety of other species, most of which are found towards the summits of our own Grampians. The more elevated parts were composed of slaty rocks; and from the snow with which they were covered the water was running in copious streams. He caught a young ptarmigan, upon which the parent bird ran so close to him that he might have taken her also. "She kept continually jumping round and round me," says he; "but I thought it a pity to deprive the tender brood of their mother, neither

would my compassion for the mother allow me long to detain her offspring, which I restored to her in safety."

About the evening of the following day, they reached a secluded spot where a Laplander had pitched his tent. Immediately after their arrival, the herd of reindeer, consisting of seven or eight hundred, came home to be milked. Some of the milk was boiled for the stranger, but it proved rather rich for his stomach. His host furnished him with his own spoon, usually carried in his tobacco-bag, and which he washed by squirting a mouthful of water upon it.

He was here joined by another guide, and after refreshing themselves by sleep they proceeded on their journey. On the sides of the hills were observed in abundance the holes of the lemming-rat; and the alpine hare occasionally presented itself. Scarcely any other fish occurs in the lakes than the char, a beautiful species of trout, with the belly of a bright-red colour. In the evening they sought in vain for one of the native dwellings. Linnæus had walked so much that he could hardly stand; and, being ready to faint with fatigue, lay down, resolving rather to endure the cold and boisterous wind than proceed any farther. But his companions at length found some reindeer-dung, which by smelling they discovered to be fresh; and, perceiving a track in the snow, they advanced till they came to a hut, where they remained all next day, it being Sunday.

It is mentioned that the reindeer of those mountains are innumerable. The herds are brought home night and morning to be milked, and are so tractable as to be easily conducted by a single driver

and a dog. The head is of a grayish colour, black about the eyes; the mouth whitish; the tail short and white; the feet encompassed with the same colour above the hoofs. The whole body is gray; darker when the new pile comes on, and lighter before it falls. The hair, like that of some other species of deer, is brittle and easily broken. The horns of the female are upright, or slightly bent backward, furnished with one or two branches in front near the base, the summit sometimes undivided, sometimes cleft. Those of the male are often two feet and a half long, and their points are as far distant from each other. They are variously branched. These animals cast their horns every year; the males about the end of November, the females in May; at first they are hairy, but the pile disappears before Michaelmas.

As the reindeer walks, a crackling noise proceeds from its feet, which is produced by the hooflets striking against each other. When these animals are driven to the place where they are accustomed to be milked, they all lie down, panting violently, and chewing the cud all the while. One of the attendants takes a small rope, and, making a noose, throws it over their heads in succession. The cord is then twisted round the horns, and the other end fastened to a stick thrust into the ground. If the milk does not come readily the udder is beaten sharply with the hand. The nipples are four, very rarely six, and all yield the fluid. After the process was finished, he observed the maid-servant taking up some of the dung, which she kneaded with her hands and put into a vessel. This was for the purpose of smearing the teats, to prevent the fawns from sucking too much.

He remained a few days among the Laplanders, who were occupied in feeding their flocks along the valleys, during which time he had an opportunity of observing their manners. He then proceeded over the range westward.

At length the mountains began to present rocks uncovered by snow, a glimpse of the ocean was obtained, and soon after the scene entirely changed. Arriving upon the abrupt edge of this elevated region, he beheld a vast expanse of forest stretching towards the sea, and presenting the semblance of cultivated fields. As he descended, the alpine plants gradually disappeared, the climate improved, and on reaching the margin of the plain, he sat down to regale himself with wild strawberries. He was struck with the circumstance, that the two natives who accompanied him showed no symptoms of fatigue. He attributes their superiority as walkers to their wearing no heels on their boots, to their being accustomed to running from their infancy, to their exemption from hard labour, to the habitual exercise of their muscles, to their chiefly using animal food, to their not overloading their stomachs, and to their being of small stature. Their continued health he imagines to be owing to the extreme purity of the air, to their eating their meat cold, to the excellence of the water, to their tranquillity of mind, to the absence of spirituous liquors, and to their being inured to cold from their earliest days.

Nothing could be more delightful to the feelings of our traveller than this transition from the severity of winter to the warmth of summer. He now approached the coast, and next day proceeded by

sea, examining the various objects that presented themselves. In the evening he arrived at the house of Mr Rask, the pastor of Torfjorden, who received him with much kindness. When day dawned he proceeded on his voyage, but was obliged by a contrary wind to put about and return to the place from which he had sailed. On the following morning, having climbed one of the neighbouring heights, he was resting on its side, when he heard the report of a gun, the ball from which struck a stone quite near him. It was fired by a native, whose intention, it would appear, had been to murder him, although, as he presently took to flight, no information could be obtained respecting his motives.

On the 15th of July he set out on his return from the low grounds of Norway, and began to ascend the snowy mountains, accompanied by an interpreter. He directed his course towards the Alps of Tornea, which were described as about forty miles distant; but having for several days endured the greatest fatigue and privation, he doubted the expediency of advancing farther, especially as he made few discoveries in natural history. He therefore, on the 23d, took leave of the mountainous part of Lapland, and returned by water towards Lulea. In this tract he had abundant opportunities of observing the peculiar characters and manners of the inhabitants, which he cursorily details in his journal. On the 26th he reached a place called Purkijaur, where he in vain attempted to procure a boat to descend the river. His attendants and he were therefore obliged to make a raft, on which they embarked; but they had not proceeded half a mile when the force of the current separated

the timbers, and with great difficulty they reached a house situated on an island.

Here he hired a man to show him the manner of fishing for pearls. This person made a raft of five logs, two fathoms in length, which he furnished with a stone anchor, a cable of birch-rope, a pole, and a pair of wooden pincers. When he reached a part which he wished to examine, he dropped the anchor, lay down at full length, looked over the edge of the raft, and on perceiving a pearl-mussel laid hold of it with the instrument. This shell is common in many of our own rivers, such as the Tay, the Ythan, the Dee, and the Don; but the pearls which it yields, although frequently large, are inferior in brilliancy to those of the true pearl-oyster, which is a marine, not a fresh-water production.

The forests having been set on fire by lightning, the flames raged with great violence, owing to the drought of the season; hence he and his guide, in crossing a part of the woods, experienced no small danger. The wind beginning to blow, a sudden noise arose, and the travellers, imagining it best to hasten forward, ran with all their might to reach the open ground. Sometimes the fall of a huge tree was so sudden that they looked aghast, not knowing which way to turn; and in one instance a large trunk fell between them, while the space by which they were separated did not exceed six feet. However, they at length effected their escape.

Visiting the Laxholms, or Salmon Islands, in this vicinity, he made observations on the fish, for the taking of which an establishment had been formed. He remarked, that the individuals of which the

lower jaw was bent inwards and attenuated, were invariably males. On the 30th July he reached the old town of Lulea, where he was detained a day by a violent storm of thunder and rain; and on the 3d of August arrived at Tornea, which stands on a small island, or rather peninsula, with a swamp for its isthmus. At this place every body was talking of a distemper to which the cattle were subject, and which attacked them principally in spring. On walking to examine the meadows to which they are first turned out, he found them covered with a profusion of the water-hemlock (*Cicuta virosa*), to which he attributed the malady. "The slightest observation," he says, "teaches us that brute animals distinguish, by natural instinct, such plants as are wholesome to them from such as are poisonous. The cattle, therefore, do not eat this hemlock in summer or autumn, whence few of them perish at those seasons, and such only as devour the herb in question incautiously, or from an inordinate appetite. But when they are first let out in the spring, partly from their eagerness for fresh herbage, partly from their long fasting and starvation, they seize with avidity whatever comes within their reach. The grass is then but short, and insufficient to satisfy them," and they eat up whatever comes in the way. The proper remedy was pointed out by the visiter; and, as from 50 to 100 of their cattle perished annually, the matter was of great importance to the inhabitants.

In the church he saw a memorial of King Charles the Eleventh's zeal for astronomical science. That prince having visited Tornea, on the 14th June 1694 saw from the belfry the solar orb at midnight,

and the following year sent Professors Bilberg and Spole to repeat the observation.

Leaving that town on the 9th August, Linnæus proceeded to Kimi, where there was a great salmon-fishery, and continued his journey through East Bothland; but finding that the Finlanders did not, or would not, understand him, he was obliged to return. He next directed his steps to Calix, and made several excursions in the neighbourhood, noting the Finnish names of articles which he might want at the inns, and again ventured to enter East Bothland. He then pursued his way along the east coast, through that district and Finland, visiting Ulea, Brabestadt, Carleby, Christina, and Abo. In the latter place he found one of his class-fellows, Mennander, who was afterwards archbishop of Upsal, and who furnished him with some money as a recompense for instructions in natural history. He then went by the post-yacht to Aland, crossed the sea of that name, and on the 10th October reached Upsal.

The whole extent of the journey was about 3800 English miles. It is quite unnecessary for us to expatiate on the dangers of such an expedition, to extol the courage and perseverance of him who accomplished it, or even to dilate on the important results. "My journey through Lapland," he says in a subsequent notice, "was the most toilsome; and I confess, that I was obliged to sustain more hardship and danger in wandering through this single tract of our northern world, than in all the travels which I undertook in other parts, though these were certainly not without fatigue. But when my journeys were over, I quickly forgot all their dangers and

difficulties, which were compensated by the invaluable fruits obtained on these excursions."

If he turned to such advantage the observations which he had made in a region but scantily supplied with the forms of animal and vegetable life, how much more profitable, it may be thought, would it have been for himself and for the world, had it been his lot to travel in some equinoctial country, teeming with the wonders of creation! Yet, perhaps the multiplicity of objects which would have forced themselves upon his notice in that richer scene, in an age when natural history was only beginning to emerge from its pristine chaos, would have bewildered the most comprehensive mind; whereas the less abundant stores of Lapland and Sweden presented themselves to him in such a way as to afford time to examine each individually, and to note the common and distinctive characters. It seems indeed more than probable, that if he had been a native of one of the warmer regions of the globe, he would not have attained such distinguished merit as a reformer of science.

SECTION III.

Studies, Adventures, and Travels of Linnæus, from 1733 *to* 1738.

Linnæus returns to Upsal—Is prevented from lecturing by Rosen; whom he attempts to assassinate—Accompanies some young Men on an Excursion to Fahlun, where he is introduced to the Governor of the Province, with whose Sons he travels to Norway—Returning to Fahlun, he delivers Lectures, falls in Love, is furnished with Money by his Mistress, and prepares to go Abroad for his Degree—He visits Hamburg, detects an Imposture there, and is obliged to make his Escape—Obtains his Degree at Harderwyk—Proceeds to Leyden, where he publishes his Systema Naturæ, and waits upon Boerhaave—Goes to Amsterdam, is kindly received by Burmann, and lodges with him—Is employed by Cliffort, publishes various Botanical Works—Goes to England, visits Sir Hans Sloane, Miller, and Dillenius—Returns to Holland, publishes several Works—Goes to Leyden, and resides with Van Royen—Publishes the Ichthyologia of Artedi, who was drowned in Amsterdam—Becomes melancholy, and falls into a violent Fever—On his Recovery goes to Paris, where he is kindly received by the Jussieus—Returns to Sweden after an Absence of Three Years and a Half.

On returning to Upsal, Linnæus was elected a member of the Royal Academy of Sciences; but this distinction was the only reward which he obtained for having undergone so many fatigues, excepting a small bursary, of which he was soon deprived. Now, however, he expected a more favourable reception in society, and in 1733 began to give public lectures on botany, chemistry, and mineralogy. Unfortunately for his success, he had not yet taken his degree,—a circumstance which legally disquali-

fied him for such an office; and a rival, Dr Nicholas Rosen, professor of anatomy, instigated, it would appear, by motives of envy, denounced him to the senate of the university. He was summoned to appear before that august body; and, although several of its members were disposed to favour him, he was prohibited from continuing his course.

Fortune then seemed bent upon thwarting him in all his projects. Stimulated by revenge, he laid wait for Rosen, and, assailing him with the utmost fury, attempted to run him through with his sword, when the bystanders interfering, wrested the weapon from his hand. For this offence he would have been expelled, had not Celsius interposed, and got him off with no other punishment than a reprimand. Men of quick tempers seldom cherish hatred; but Linnæus was of a peculiar disposition,—ambitious, confident of superiority, irritable, and obstinate. Moreover, he was in desperate circumstances, utterly destitute of all means of subsistence, and the world seemed to have conspired against him. He was still determined to stab his enemy to the heart, should he ever meet him in the streets. The conflict of his mind, under such excitement, must have been truly painful. He awoke one night from a dream of horror, seriously considered what he was about, and resolved, instead of assassinating Rosen, to expel the demon from his own breast.

An assistant-professorship being vacant in the University of Lund, he endeavoured to procure it, but, although his claims were supported by Stobæus and others, was unsuccessful. Prohibited from lecturing, he was only prevented from falling into despair by the consciousness of superior intellect, by

cherishing a plan of botanical reform, and by still fixing his eyes on the prospect, however distant, of future independence. In the mean time, some of his former pupils, resolving to make an excursion to Norberg, Bipsberg, Afwestadt, Garpesberg, and Fahlun, solicited the benefit of his knowledge and experience in conducting their researches.

At the last-named town, where he occupied himself assiduously in exploring the mines, he was introduced to Baron Reuterholm, governor of the province of Dalecarlia, who was fond of natural history, and especially of mineralogy. Having two sons whom he was desirous of sending upon a journey, for the purpose of improving themselves in that department of science, he resolved to place them under the guidance of Linnæus. They set out in the spring of 1734, and extended their travels as far as the mines of Roraas in Norway.

Returning to Fahlun, he commenced lecturing on mineralogy, under the patronage of the governor, and found himself in all respects more comfortably situated than he had ever been at Upsal. He also obtained some employment in the medical line, and contracted an intimacy with John Browall, the tutor of the baron's children, who afterwards became bishop of Abo. Although he was now in comparatively easy circumstances, his friend advised him to procure a degree, and settle as a regular practitioner. This, however, being impracticable, on account of his want of funds, he turned his thoughts to matrimony, in the hope of being able to accomplish a suitable establishment.

There was a physician at Fahlun named More, or Moræus, who was reputed rich, and in fact was

one of the wealthiest individuals in the district. He had two daughters, of whom the elder, Sarah Elizabeth, was in all respects to the mind of Linnæus, who became a frequent visiter, and soon ingratiated himself with the family. Finding that the object of his choice was not less pleased with his person and manners, he determined to ask her in marriage; and, summoning all his resolution, made known his views to her father, who, although he had no objection to the character of the suitor, was little satisfied either with his fortune or his prospects. However, he promised that, should he succeed in obtaining his diploma, the young lady should be consigned to him after a period of three years.

It was customary at this time for Swedish students to take their degree at some foreign university, where it could be procured at the least expense. Hitherto Linnæus had been unable to qualify himself in this respect for the practice of his profession; but love now came to the aid of ambition. Miss Morœus, who was thrifty as well as handsome, had saved about 100 dollars of the pocket-money which she had received at various times, and offered them to her lover. To this sum he succeeded in adding a little by his own exertions, though the whole did not amount to more than thirty-six Swedish ducats.

After visiting his friends, weeping over the grave of his mother, who had died some months before, preparing his academical dissertations, and arranging his papers, he set out from Fahlun, in April 1735, accompanied by a young man named Sholberg. Travelling through the southern provinces of Sweden, Jutland, and Holstein, he arrived at Hamburg, where he remained for some time, in-

specting the collections and curiosities which that celebrated city contained. In the museum of John von Spreckelsen was a preparation of great value, presenting the appearance of a serpent with seven heads. It had even been pledged for a loan of 10,000 merks, and was in fact considered one of the most remarkable objects in the cabinets of the curious. Linnæus, however, on minutely inspecting the monster, discovered that the heads consisted of the jaws of a small quadruped covered over with the skin of a serpent. The wonder ceased, Spreckelsen nearly became bankrupt, and the stranger was obliged to leave Hamburg in order to avoid the enmities in which his sagacity had involved him.

Continuing his journey to Holland, he arrived at Harderwyk at the end of May, and made application for his degree, which he received on the 24th June. His thesis was on intermittent fevers, one of the principal causes of which he maintained to be water impregnated with argillaceous substances. Though he had now accomplished his chief object, he resolved, before returning to Sweden, to make himself known to some of the Dutch literati; and for this purpose proceeded to Leyden, where he hired a lodging. Here he made the acquaintance of Professor Royen, Dr Van Swieten, Lieberkuhn, Gronovius, and several others.

By the advice and assistance of the last of these scholars, he published his Systema Naturæ, in fourteen folio pages. This little work, containing a compendious classification of the three kingdoms of nature, was very favourably received. Boerhaave, one of the most illustrious physicians that the world has ever seen, was at the same time the most eminent

individual in the University of Leyden. Linnæus was therefore anxious to see him; but finding an interview impracticable in the ordinary way, on account of the great man's constant occupation, he resolved to send him a copy of his treatise, accompanied with a letter. The consequence was an invitation to meet him at his villa near the city, where he had a botanical garden. On entering into conversation with the young foreigner, the venerable professor, astonished at his knowledge, strongly advised him to remain in Holland, where he might be sure of making a fortune; but the other, prevented by poverty from adopting this counsel, was obliged to set out on the following day.

Arriving at Amsterdam with a recommendation to Professor Burmann, he was kindly received by that gentleman, who was then occupied with his description of the plants of Ceylon. Linnæus himself relates the occurrences which took place during this interview: "'Do you wish to see my plants?' asked Burmann, 'which of them would you inspect?' He held out one, and observed, 'It is very rare.' I begged a single flower, which I examined after softening it in my mouth, and pronounced it to be a species of laurus. 'It is not a laurus,' said Burmann. 'But it is,' said I; 'it is the cinnamon-tree.'—'It certainly is the cinnamon,' rejoined Burmann. I then convinced him that this tree was a species of laurus, and so of other plants. At length he said, 'Will you help me with my work on Ceylon, and you shall lodge with myself?'" To this proposal the other assented, delighted with the prospect of at once adding to his reputation and his knowledge.

In Burmann's house he found a collection of natural objects and an extensive library, both of which were of great use to him. The time passed pleasantly enough, and he deferred his return to Sweden till the following spring; about which period, a circumstance occurred that proved of great advantage to him. Dr George Cliffort, burgomaster at Amsterdam and one of the directors of the Dutch East India Company, who was a zealous lover of natural science, was in need of a domestic physician to take daily care of his health. Boerhaave, who was his medical attendant, recommended Linnæus, whom he represented as being also an excellent botanist, and capable of arranging his botanic garden. Cliffort accordingly invited Burmann and Linnæus to Hartecamp, his villa, where they found many new plants from the Cape of Good Hope. The young Swede pointed out those which had not been described, and evinced so accurate a knowledge of botany, that the burgomaster made him a proposal of free board and lodging, with a salary of 1000 florins. The terms were accepted with no small satisfaction.

This year he published a tract which he had commenced at Upsal,—his Fundamenta Botanica,—in which he exhibited the basis of his new system in 365 aphorisms. About the same time he printed his Bibliotheca Botanica, another small work, the materials of which he had found in the libraries of Spreckelsen, Burmann, Gronovius, and Cliffort. A description of the banana-tree (*Musa paradisiaca*), which had flowered in the garden of his patron, formed the subject of a third treatise. The Imperial Academy of Naturalists at Vienna admitted him as a member, under the honourable appellation

of Dioscorides the Second, and his name began to be known throughout Germany.

Cliffort being desirous of extending his collection by obtaining new species from England, resolved to send Linnæus to that country, which he did in the latter part of July, limiting the period of his absence to twelve days. The passage from Rotterdam to Harwich occupied eight; and the stranger, finding himself surrounded by attractions, was in no haste to return, even to the elysium of Hartecamp. He arrived in London, with a letter of introduction from Boerhaave to the celebrated Sir Hans Sloane. Whether the venerable physician meant to make merry at the expense of the naturalists, or whether he really thought they both deserved the compliment which he paid to them in his note, let the reader determine:—"Linnæus, who will give you this letter, is alone worthy of seeing you, alone worthy of being seen by you. He who shall see you both together shall see a pair, whose like will scarcely be found in the world."

Notwithstanding this high encomium, Sir Hans exhibited no kindliness of feeling towards him. He was in fact a person who had grown old in self-esteem. Cliffort was desirous of procuring some plants from the garden at Chelsea, and his agent accordingly waited upon Mr Miller, who listened to his request with very little respect. At a subsequent visit, however, the Englishman became in some degree sensible of the merits of the young foreigner, and furnished him with the specimens which he had solicited. Proceeding to Oxford, he presented himself before the celebrated Dillenius, professor of botany, who received him much in the

same way as the others had done. "See," quoth Dillenius to his patron Sherard, who happened to be present at the interview, "this is the young man who confounds all botany." Although the Swede was ignorant of the language spoken by these islanders, he readily guessed at the meaning of "confounds," but thought it prudent to take no notice of the accusation. They then went to the garden, but the professor still treated the presumptuous youth with undisguised contempt. Next day, he waited upon Dillenius previous to his departure. "Before I go," said he, "I have one favour to request; tell me why you lately used those words about confounding botany." He refused to explain; but when Linnæus insisted that he should, "Come this way," said he; so the sheets of half of the Genera Plantarum were referred to. On almost every page were the letters N. B. When he asked what they meant, Dillenius said they marked the false genera. He maintained that the genera were not false, and the Oxonian referred to a plant in the garden, which he and other botanists considered as having three stamens. It was found to have only one, as his opponent had alleged. "O!" quoth Dillenius, "it may be so accidentally in a single flower;" but behold, all the flowers were the same; for when they examined a number, all turned out as the Swedish youth had described them. The professor had been slow of belief, it is true; but he now gave due honour to his visiter, detained him several days, and supplied him with all the plants which Cliffort required.

In a letter to his friend Dr Richardson, dated August 25, 1736, Dillenius expresses the following

opinion of him :—" A botanist is arisen in the North, who has founded a new method on the stamens and pistils, whose name is Linnæus. He has published Fundamenta Botanica, Bibliotheca Botanica, Systema Naturæ; and is now printing in Holland his Characteres, and his Flora Lapponica. He is a Swede, and has travelled over Lapland. He has a thorough insight and knowledge of botany, though I am afraid his method will not hold. He came hither, and stayed about eight days, but is now gone back to Sweden."

On his return to Holland, which took place in September, Linnæus continued his researches with increased diligence. In the course of the year 1737, he laid before the scientific world about two hundred printed sheets, not of compilation, nor of fiction, but for the most part completely original. The Genera Plantarum, containing the characters of all the genera of plants according to the number, form, situation, and proportion of their organs of generation, was the first work published by him after his return from England. This treatise exhibited 935 genera, to which were added during the same year sixty others, in a supplement, to which he also appended a concise view of his system. A full account of the plants observed by him in Lapland, arranged according to the method invented by himself, formed his next undertaking. It was dedicated to the Royal Society of Upsal, and contained a brief physico-geographical description of the country. At the solicitation of Gronovius, he permitted one of the productions of that northern region to be named after himself, *Linnæa borealis*. The great object of his residence at Hartecamp was now

completed by the publication of his Hortus Cliffortianus, in which were described all the species of plants cultivated in the burgomaster's garden. The Critica Botanica, in which he attempted to reform the absurd nomenclature that then prevailed, and the Viridarium Cliffortianum, describing the greenhouse-plants of Cliffort's establishment, were the other books published by him during this year.

Boerhaave, who had been in a great measure the author of his good fortune in Holland, now procured for him the appointment of physician in ordinary to the Dutch colony of Surinam, which, however, he declined, both on account of the insalubrity of the climate, and because he could now entertain the prospect of a more eminent station. He therefore recommended a young friend named Bartsch, who died in six months after his arrival in South America.

When about to depart from Leyden, Linnæus went to take leave of Boerhaave. The interview, which, however melancholy, was very flattering, is thus related by him: "That great man, who was affected with a dropsy of the chest which forced him to keep himself always sitting in his bed to prevent suffocation, would not receive visiters, but admitted me to bid him farewell. Summoning the little strength that remained in him, he raised my hand to his lips, and said: 'I have finished my career, and all that I have been permitted to do I have done; may God preserve you, who have yet a greater task to perform! What the learned world expected from me it has obtained; but it expects much more from you, my dear son. Farewell, farewell, my dear Linnæus!'"

Having gone with Cliffort to Amsterdam, and afterwards to Leyden, he visited among others his friend Van Royen, professor of botany, who having made proposals of marriage to Miss Boerhaave, the sole heiress of the great physician, had been rejected, and therefore vowed hostility to the family. The botanic garden there had been arranged and described agreeably to Boerhaave's method; but the other now resolved to alter the disposition, and adopt the system of Linnæus. He accordingly offered him a salary of eight hundred florins, if he would live with him, and assist in the execution of this scheme. Influenced by respect for his deceased friend, he would not countenance the alteration, although he devised a plan by which neither his benefactor nor himself should receive the honour. He remained with Van Royen, classed the plants after a principle of his own invention, and drew up a catalogue of them, which was published in the name of that teacher.

The next work which he printed was produced by the genius and industry of Artedi. When he resided at Leyden, previous to his going to Hartecamp, he had the pleasure of meeting this friend of his youth, who had left Sweden in 1734, and gone to England to prosecute his scientific labours. From thence he went to Holland for the purpose of obtaining his degree, which he was unable to accomplish on account of his extreme poverty. Linnæus recommended him to Seba, an apothecary at Amsterdam, and author of a large work on natural history, who received him as his assistant. But soon after, returning home in a dark night, he fell into a canal and was drowned. His countryman had the melan-

choly satisfaction of depositing his remains in the grave; and having induced Cliffort to purchase his manuscripts, which were detained for debt, he arranged and committed them to the press. This tract, in his opinion, was the best that had appeared on the subject of fishes. He also published his own Classes Plantarum, in which he presented a general view of all the botanical systems that had been previously proposed.

His ambition was now on the point of being attained. Not only were his works received with approbation, but his principles had been adopted by several teachers. He had also formed connexions in Holland which promised to be of the greatest advantage to him; and the Dutch, desirous of securing his services, proposed that he should make a botanical voyage to the Cape of Good Hope, with the promise of a professorship on his return.

But Linnæus about this time was seized with an ardent desire to revisit his native country, and fell into a state of extreme depression of spirits, succeeded by a violent fever, which lasted upwards of six weeks. His excessive application to study may be considered as the source of his complaints; and perhaps to this may be added his disquietude concerning the daughter of Moræus. But it does not, however, appear that his love for Elizabeth was equal to that for botany or even for his own renown; for though the stated period had elapsed, he still resolved to make a journey to Paris before returning to the place of his birth.

He reached that capital in the beginning of May 1738, and was kindly received by the two Jussieus,

one of whom was the successor of Tournefort.—It is related by M. Fée, that on his arrival he went first to the Garden of Plants, where Bernard de Jussieu was describing some exotics in Latin. There was one which the demonstrator had not yet determined, and which seemed to puzzle him. The Swede looked on in silence, but, observing the hesitation of the learned professor, cried out,—"Hæc planta faciem Americanam habet,—It has the appearance of an American plant." Jussieu, surprised, turned about quickly and exclaimed,—"You are Linnæus."—"I am, sir," was the reply. The lecture was stopped, and Bernard gave the learned stranger an affectionate welcome. Through the kind offices of these amiable men and excellent botanists, he was introduced to many of the literati of Paris, and obtained access to the libraries, collections of natural objects, and public institutions. The French, however, were by no means disposed to adopt his views: "He is a young enthusiast," they said, "who confounds all, and whose only merit consists in having reduced botany to a state of anarchy." He was, notwithstanding, admitted a corresponding member of the Académie des Sciences. He then visited Versailles, accompanied by his two friends, who defrayed all his expenses, and showed him the public libraries, the museums, and the most celebrated private collections, especially that of Reaumur. "Linnæus," says he, in his autograph memoirs, "was now desirous of returning to Sweden without further delay, for time seemed to him too valuable to allow him to engage in studying the manners and language of the French. He never had a genius for languages, nor could he ever render

himself familiar with the English, French, German, or even the Lapland tongues. He felt the same difficulties with respect to Dutch, although he had resided three years in Holland. This, however, fortunately did not prevent him from making himself sufficiently understood. After seeing all the curiosities at Paris, he went to Rouen in the dog-days. There he embarked for the Cattegat, with a favourable wind, and after crossing the Sound landed at Helsingburg. He immediately visited his old father at Stenbrohult, rested there a few days, and set out for Fahlun. After being formally betrothed to his bride, he proceeded to Stockholm, where he arrived in September."

He had left his native country in April 1734, and returned in the autumn of 1738, having been absent three years and a half. In the course of this period, he visited Holland, England, and France, formed acquaintance with many eminent naturalists, obtained his medical degree, published numerous works on botany, and extended his fame over all Europe.

With respect to the improvements which he made in that branch of natural history, it is unnecessary here to enter into any detail, as it is proposed to speak particularly of them in a subsequent volume. It may be sufficient to remark, that there had not previously been any good arrangement of plants; that the principles of the science had not been laid down in a satisfactory manner; that the nomenclature was barbarous and unsuitable; the mode of distinguishing species rude and inefficient; and that, in short, the works on this subject were little better than a chaos of names and unintelligible descriptions. Some

writers maintain, indeed, that he did more harm than good, when he became the legislator of botany. But their opinion can deceive those only who, too idle or too weak to judge for themselves, adopt the sentiments of their teachers with a deference unworthy of the student of nature.

SECTION IV.

Principal Events in the Life of Linnæus from 1738 *to* 1741.

Linnæus is treated with Neglect at Stockholm—Is offered a Botanical Professorship at Gottingen, but prefers remaining in Sweden—His medical Practice is at length extended—He prescribes for the Queen, and becomes acquainted with Count Tessin, who procures for him the Offices of Lecturer to the School of Mines and Physician to the Admiralty—He marries Miss Moræus, delivers Lectures on Botany, and becomes a Candidate for the Botanical Chair at Upsal, which, however, is given to Rosen—Is sent to examine the Islands of Oeland and Gothland—Being appointed to succeed Roberg in the Chair of Medicine and Anatomy, he goes to Upsal, is reconciled to Rosen, and delivers his Introductory Discourse—Linnæus and Rosen exchange Professorships—The Botanic Garden is restored, and a House erected for the Professor, who enters upon his Duties with Ardour.

LINNÆUS had naturally expected, on returning to his native land, to enjoy the fruits of his labours, and if not to step at once into a lucrative office, to receive, at least, the honours which he imagined to be due to him. This hope, however, was more the result of a strong confidence in his own powers, and of the high sense which he entertained of his merits, than of sound judgment, which might have taught him that time was yet required to render him known to his countrymen, and address or accident to bring him into the notice of those who might interest themselves in his behalf. He had forgotten that a prophet is usually less esteemed at home than any where else. At Stockholm he was

treated with neglect, and even with contempt. Science in the North had few gifts to bestow; and, in order to obtain the means of subsistence, he found himself once more obliged to attempt the practice of medicine. In this, however, he had very little success, public opinion being opposed to the professional qualifications of one who had merely the reputation of being an aspiring botanist; and in the capital he seemed destined to undergo hardships similar to those which he had experienced at Upsal. In this, perhaps, the inhabitants judged rightly; for the important office of a physician certainly ought not to be assumed by one who has resolved to devote the greater part of his time to studies unconnected with the healing art. The only favour, he says, which was at this time conferred upon him was his being elected a member of the Academy of Sciences of Upsal; and he would have again left Sweden had not his Elizabeth prevented him.

In this perplexed condition he remained until the summer of 1739, when the tide of misfortune began to ebb. At this time he received from his friend, the illustrious Haller, an offer of the botanical professorship at Gottingen, which, however, the prospect of success in his own country induced him to reject. The first turn in his affairs was caused by his having cured two young men of debility brought on by long excesses; and in less than a month he had under treatment most of the profligates in the capital. Soon afterwards a catarrhal fever or influenza became prevalent. He happened to be called to visit, among others, the lady of an Aulic councillor, for whom he prescribed a remedy which she was directed to carry about her for occa-

sional use. This lady being one day at court, and engaged in a card-party, was following his direction, when the queen, Ulrica Eleonora, asked her what it was she from time to time put into her mouth. Upon being informed, her majesty, who was herself troubled with a cough, immediately sent for Linnæus, who recommended the same medicine, by which the complaint was removed.

This fortunate accident completely established his popularity, and he now became the fashionable doctor of the place. About the same period he was elected president of a society instituted by Captain Triewald for the improvement of the national language,—a circumstance which also tended to promote his reputation. He had, moreover, the good luck to become acquainted with the celebrated Count Charles Gustavus Tessin, who being himself fond of natural history, could not fail to take an interest in one who had undeservedly suffered so much obloquy for his devotion to it. The nobleman asked him if there were any office for which he wished to petition, as the Diet was then sitting. He replied that he wanted nothing; but his patron having allowed him a day to consider, he consulted his friend Triewald, who advised him to ask the office of lecturer to the School of Mines, which brought about a hundred ducats a-year. The count soon after invited him to dinner, when he informed him that the request had been granted. In a short time the more important office of physician to the Admiralty became vacant, and was procured for him by his Mæcenas, who, besides, offered him apartments in his house, and frequently admitted him to his table. There he had an opportunity of making

the acquaintance of many persons of influence, by whose means his credit was greatly extended.

Being now in prosperous circumstances, he resolved to complete the contract into which he had entered with the daughter of old Moræus, and proceeding to Fahlun, received her in due form. After spending a month of merrymaking, he returned to Stockholm. In September he resigned the presidency of the Academy, and, agreeably to the rules of the institution, delivered on that occasion a discourse on insects (De Memorabilibus in Insectis), which was afterwards printed.

In the summer of 1740, he delivered a course of lectures on botany, and published a new edition of his Fundamenta Botanica, which he dedicated to Dillenius, Haller, Van Royen, Gronovius, Jussieu, Burmann, and Ammann; showing, in this classification, his opinion of the comparative merits of the most eminent botanists of that time. His medical practice continued to increase; and with his lectures, his private studies, and his duty as physician to the Admiralty, his time was fully and satisfactorily occupied. His former protector, Olaus Rudbeck the younger, professor of botany, having died in the spring of this year, Linnæus, Rosen, and Wallerius offered themselves as candidates for the vacant office. Count Tessin supported the first mentioned; but the chancellor, Count Gyllenborg, gave Rosen the preference, as he had taken his degrees before the other, and had acquired stronger claims on the public by a longer residence at Upsal. The king, however, was desirous of bestowing the office on the great botanist, who was consoled for the loss by the promise of succeeding Roberg, who held the chair

of medicine and anatomy. That gentleman, being advanced in years, requested permission to resign, which was granted; but although the appointment had been promised to Linnæus, it was not without difficulty that he obtained it. In the mean time, Wallerius, his rival, took every opportunity of impugning his botanical doctrines, with the view of lessening the estimation of his merits; though the effort tended only to bring himself into contempt.

The affair was brought before the Diet in 1741, when it was decided that Linnæus should be preferred to the vacant place. War having broken out between Sweden and Russia, he was apprehensive of being obliged to officiate as physician to the fleet; and finding that the government had resolved upon sending persons to explore the least-known parts of the Swedish provinces, for the purpose of promoting domestic manufactures, he made application for this office also, which was granted to him. Accompanied by six of his friends, to each of whom was assigned a separate department, he accordingly examined the islands of Oeland and Gothland, with the view of discovering any earth that might answer for the making of porcelain, and of bringing to light such ingredients, mineral or vegetable, as might be useful in medicine, dyeing, and domestic economy. The expenses of the journey were defrayed by the Board of Manufactures. In the course of this expedition, he narrowly escaped breaking his leg while descending into an alum-pit; was nearly suffocated among the snow in the vicinity of Blakulla; and experienced great danger from a violent storm while crossing from Gothland to Upsal. Although he was unable to accomplish the chief object of his mission, he

made numerous observations on the antiquities of those islands, their natural productions, fisheries, and the manners of their inhabitants. The States gave him a public acknowledgment of their satisfaction, and the narrative of his tour was published four years afterwards.

On arriving at Upsal in September, he made a sincere peace with his old antagonist Rosen, proposing to him a mutual oblivion of the past. In October, he assumed his professional duty as successor to Roberg; on which occasion he delivered a discourse on the advantages of examining the interior of the country,—De Peregrinationum intra Patriam Necessitate. Towards the end of the year, Rosen and he entered into an amicable negotiation, the result of which was an interchange of offices; the former taking the chair of anatomy and physiology, and resigning to the latter that of materia medica, botany, dietetics, and natural history.

No man of eminence, in any department of science or literature, has been without enemies. Linnæus could not, therefore, expect to become an exception to the general rule. It is doubtful whether Haller manifested more kindness or enmity towards him; or it may be said that though he remained his friend, he yet took many opportunities of uttering censure. A more violent opponent appeared in Heister, professor at Helmstadt, who, imagining himself a great botanist, was offended by the pretensions of the Swedish naturalist, and stirred up one of his pupils, Dr Siegesbeck, a man of even less knowledge than his master, to fight his battle for him. The representations of this last had, for a time, considerable influence over the fortunes of Linnæus, and Heister

secretly rejoiced at his success; while he excited partisans every where to wage war against the sexual system. Other adversaries started up in Germany, France, and various parts of Europe. The only open antagonist whom he had in his own country was the celebrated Wallerius, the mineralogist; in order to counteract whose unfair criticisms he published a pamphlet entitled Orbis Eruditi Judicium de Car. Linnæi, M.D. Scriptis,—The Judgment of the Learned World on the Writings of Charles Linnæus, M.D. This is the only defence that he ever made of himself, and the only work which he published anonymously. It contained merely a short sketch of his life, a list of the books published by him, and testimonials and opinions of celebrated individuals respecting his merits. Whatever vexation these attacks may have given him, they had no permanent influence, and he had the happiness of triumphing over all opposition. With reference to the attacks of Siegesbeck, he thus writes from Hartecamp to Haller:—

"I have received from a friend Professor Siegesbeck's Verioris Botanosophiæ Specimen, with his Epicrisis on my writings. This author has been very hard upon me. I wish he had written these things when I was first about publishing. I might have learned when young, what I am forced to learn at a more advanced age, to abstain from writing, to observe others, and to hold my tongue. What a fool have I been, to waste so much time, to spend my days and nights in a study which yields no better fruit, and makes me the laughing-stock of all the world! His arguments are nothing; but his book is filled with exclamations, such as I never

before met with. Whether I answer him or keep silence, my reputation must suffer. He cannot understand argument. He denies the sexes of plants. He charges my system with indelicacy; and yet I have not written more about the polygamy of plants than Swammerdam has about bees. He laughs at my characters, and calls upon all the world to say if any body understands them. I am said to be ignorant of scientific terms. He judges me by the principles of Rivinus, and hundreds of the vilest scribblers. Inasmuch as the man humbles me, so do you, whose learning and sense have been made sufficiently evident, exalt me. It distresses me to read the commendations you are pleased to heap upon so unworthy an object. I wish there might ever be any reason to expect that I could evince my gratitude and regard for you. I hope life will be granted me, to give some proof of my not being quite unworthy."

Linnæus was now, however, in his proper element, and commenced his academical career with great ardour. The botanical garden, founded by the celebrated Olaus Rudbeck about fifty years before, was entirely destroyed by the dreadful fire which, as already mentioned, had, in 1702, converted the greater part of Upsal into a heap of ruins, and now served no more important purpose than that of pasturing a few cows. His first efforts were directed towards its renovation, which he soon succeeded in accomplishing. Count Gyllenborg, who was then chancellor of the university, was a man of considerable scientific attainments, and had a special love for botany. This circumstance, as well as his interest in the prosperity of the institution, induced him to lend a ready ear to

the solicitations of the professor, and to give his important aid to the undertaking. Baron Harlemann, the king's architect, furnished the plan. Hothouses were erected, walks formed, ponds dug, plots furnished with plants; in short, the garden soon assumed a most promising appearance. A house was also built for the accommodation of the teacher, who had no longer any cause to complain of the neglect of his countrymen. In the early part of this year his wife presented him with a son; so that in all respects he was a happy man.

At this point ends the more romantic portion of this illustrious individual's life. His continued struggles for subsistence, for the acquisition of knowledge, for fame, for an honourable independence, were now crowned with success. His rivals had shrunk from the contest, his calumniators had fallen into deserved obscurity, his merits had been acknowledged at home and abroad, his perseverance, his ardour, and his acuteness of observation, were duly estimated. While yet in the vigour of manhood, he had attained the honour and emolument that are often deferred to cheer only the declining years of the votary of science. On the other hand, how many individuals have toiled through a life of continued misery, without ever reaching that haven into which the gentle breezes of prosperity had already wafted our ardent adventurer.

SECTION V.

Commencement of Linnæus's Academical Career.

Linnæus restores the Botanic Garden at Upsal—Takes Possession of his new Residence—Founds a Natural History Museum—Publishes Catalogues of the Plants and Animals of Sweden—In 1746, makes a Journey to West Gothland—Medal struck to his Honour—He publishes a Flora of Ceylon from the Herbarium of Hermann—His alleged Discovery of a Method of producing Pearls—Success as a Professor—Malice of his Enemies—Journey to Scania—Is appointed Rector of the University—Attacked by Gout—Sends several of his Pupils to travel in foreign Countries.

UNDER the fostering care of Linnæus, the botanical garden of Upsal was gradually enriched by donations from numerous friends. In the year 1742, he introduced into it more than two hundred indigenous species, while he sent a student to Norway to collect rarities. An experienced gardener, whom he had formerly known with Mr Clifford, was engaged to take charge of it. Some idea may be formed of his zeal, from the circumstance of his having the first year sown seeds of 567 different species, the next year of 600, and the third of more than 1000. Plants and seeds were liberally transmitted from Berlin by Haller and Gleditsch, from Leipsic by Ludwig, from Yevern by Dr Moehren, from Stutgard by Gesner, from Paris by Jussieu, from Montpellier by Sauvages, from Oxford by Dil-

lenius, from London by Collinson, Miller, and Catesby, from Leyden by Gronovius, from Amsterdam by Burmann, and from Petersburg by Gmelin and Ammann. He even received seeds from Louis XV.; and the Baron Bjilke brought him from Russia a great number of plants, collected in Siberia by Messerschmidt, Gerber, Heller, Heinzelman, and others, most of them not previously described. From Holland he also obtained the Musa, a tree which he considered himself extremely fortunate in possessing.

Six years after the restoration of the garden, he published a description of it under the title of the Hortus Upsaliensis. At this time, the number of exotic plants which it contained amounted to 1100. A learned traveller, who visited it in 1771, writes as follows:—"An iron gate of excellent workmanship leads to it from the road. At the top of the gate are displayed the Swedish arms, and those of Count Gyllenborg, who so zealously promoted its restitution. Within, a large court presents itself to view; on the right stands the house of Linnæus, who is the director of the garden, and on the left are some other buildings. A straight avenue leads by another gate to the garden, which is separated from the court by a neat wooden railing. The garden itself is laid out in a superb style. The greater part consists of two large tracts of ground, one of them containing the perennial, the other the annual plants. Each of these tracts is divided into forty-four beds, surrounded with a low hedge and small doors. The plant-house is divided into the greenhouse, the hothouse, and the thriving-house, which form the northern side; the gardener's cottage, which is on the southern; the

thriving-bank on the west; and the grass-bank on the east. The sun-house faces the ponds, into which fresh water is conveyed by pipes."

The professor took possession of his beautiful residence in 1743, and delivered a course of lectures on dietetics, which was numerously attended. The same year he was elected a corresponding member of the Academy of Montpellier. In 1744, Prince Frederick visited the university for the first time, when the professors were presented to him. Celsius and Linnæus were complimented with the title of *lumina academiæ*, on account of their great learning and reputation. Some months after this occurrence, the same prince was received at Upsal by the rector and professors; on which occasion Linnæus alone was invited to follow him to Ekhelsund, where he had a private interview. In October, he was appointed secretary to the university, in the place of Andrew Celsius, professor of astronomy, who had died in the preceding spring, and in November was made medical inspector of Smaland, an office which had also been possessed by the same individual.

In the following year, he founded a museum of natural history at the botanic garden; the prince-royal and Count Gyllenborg furnishing the first collection of animals. In autumn, he published two important works, the Flora Suecica and the Fauna Suecica, in the composition of which he had laboured occasionally during fifteen years. The former contained descriptions of 1140 species of plants indigenous to Sweden, with their medical and economical uses, their stations, and other useful information; the

latter exhibited the characters of 1350 animals occurring in the same country. In a subsequent edition this number was increased to 2266.

In the summer of 1746, he made a journey to West Gothland, accompanied by several of his students, and, on returning, devoted himself to the completion of his work on the species of plants. To favour his views, and contribute to the extension of science, Count Tessin obliged the East India Company, who at this time had their charter renewed, to send out every year to China, at their own expense, a young naturalist, to be selected by Linnæus. The same year he received a very flattering testimony of respect from four patriotic noblemen, the Barons Harlemann, Hopken, Palmstjerna, and Count Ekeblad, who caused a medal to be struck in honour of him as well as of his patron, the Count Tessin. One side represented the bust of Linnæus, with these words:—

Carol. Linnæus, M. D., Bot. Prof. Ups. Ætat. XXXIX.

On the other were the following:—

Carolo Gustavo Tessin et immortalitati effigiem Caroli Linnæi Cl. Ekeblad, Andr. Hoepken, N. Palmstierna, et Car. Harlemann. Dic. MDCCXLVI.

This mark of respect to the distinguished naturalist and his illustrious friend proved so agreeable to the latter, that it induced him to order a piece to be stamped, representing on the one side a likeness of the professor, and on the other three crowns, indicative of his dominion over the three kingdoms of nature, with the sun casting his beams on them, as

emblematic of the genius of the North illuminating the mundane system. *Illustrat,*—He illumines,—was the appropriate motto. It is not in infancy only that men are "pleased with a rattle, tickled with a straw;" nor are flattery and presumption peculiar to any age.

In January 1747, the King of Sweden conferred on Linnæus and his issue the title of First Physician, or Dean of the College of Physicians; and soon after he was elected a member of the Royal Academy of Berlin.

Professor Hermann of Leyden, who, towards the end of the preceding century, had been sent to Ceylon and other parts of India, for the purpose of examining the spice-plants, died soon after his return, and his collections fell into the hands of Mr Gunther, apothecary at Copenhagen. This person, desirous of knowing what they contained, sent them to Holland; but receiving from thence information that Linnæus was the only person who could satisfy him, he finally addressed them to Upsal. Delighted with this oriental treasure, which had been lost half a century, the botanist examined it with the greatest attention, and, on completing his laborious task, published the result under the name of Flora Zeylanica. At the same time he gave to the world an account of his journey to West Gothland.

It is stated, that about this period he made an important discovery relative to the formation of pearls in the river-mussel (*Unio margaritifera*), a shell of common occurrence in the northern parts of Europe as well as in our own country, and from which are obtained all our indigenous pearls, which not

many years ago were held in considerable estimation. By injuring the shell, probably by means of puncture or perforation, it is supposed that he succeeded in causing a deposition of the pearly matter, so that one might procure a certain quantity at pleasure. The precise method, however, is still uncertain, nor is it believed to have been generally successful; at all events the secret has been entirely lost.

At this period, says Linnæus, botany was cultivated at Upsal with unparalleled ardour. Frequent excursions were made for the purpose of collecting plants, insects, and birds. Every Wednesday and Saturday herbarizations took place, which continued from dawn to night. The pupils, having their hats covered with flowers, returned to the town, and preceded by musical instruments accompanied their professor to the garden.

But amid all this success he was harassed by the malice of his enemies. A decree of the senate appeared, which prevented any native of Sweden from publishing a work in a foreign country. This was evidently directed against him alone, for, as he says, it could apply to no other person. In a fit of bad humour he flung his pen from him, and swore that he would never write another book. At this period also a person named Fick endeavoured, by disgraceful calumnies, to injure him in the esteem of his fellow-citizens. This conduct he felt so much the more severely, because the slanderer was one of his familiar friends, which was also the case with respect to Halenius, who openly censured one of his dissertations, although he had approved of it

before it was sent to press. About the same time he received a letter from Haerlem, which he says nearly cost him his life, and prevented him from sleeping for two months. The purport of this communication has not been disclosed; but, surely, if he had not placed too much value on the opinion of the world, he would have allowed the malice of his enemies to vent itself in impotent rage.

His self-love, however, was soon gratified by the arrival of a pupil from Paris, the first who had come to him from a foreign country, and by the presence of several persons of distinction at his excursions. This year he had a hundred and forty students at his lectures.

The following year, after publishing a work on Materia Medica, he was directed by the Diet to make a journey to Scania or Schonen, the most northern of the Swedish provinces, for the purpose of examining its natural productions. This was the sixth and last tour which he made in his native land. On returning he visited his brother Samuel at Stenbrohult. During his absence he was appointed rector of the university, and towards the end of the year entered upon the duties of his new office.

In 1750, he continued his lectures with his wonted energy and success. The king and queen had commenced a collection of objects belonging to natural history, which were kept at Ulrichsdahl or Drottningholm, about eight Swedish miles from Upsal. Thither he used to repair during the summer and winter vacations, for the purpose of arranging and describing the various specimens. But a violent

attack of gout obliged him to relinquish for a time all his occupations.

On his recovery he laboured at his Philosophia Botanica, which appeared in the following season, together with an account of his journey to Scania. During this and the preceding year, he sent out several of his most distinguished pupils to travel in various parts of the world.

SECTION VI.

Travelling Pupils of Linnæus.

Enthusiasm excited by the Lectures of Linnæus—Ternstroem dies on his Voyage to China—Hasselquist, after travelling in Egypt, Arabia, and Palestine, dies at Smyrna—Forskal perishes in Arabia; Lœfling in South America; Falk in Tartary—Kalm sent to Canada; Rolander to Surinam; Toren to Malabar; Osbeck to China—Sparrmann travels in the Cape, and accompanies Cook on his second Voyage—Thunberg visits Japan, Ceylon, and other Countries—Various parts of Europe visited by Pupils of Linnæus—Remarks on the Accumulation of Facts produced by their Exertions.

THE enthusiasm excited by the lectures and demonstrations of Linnæus, seems to have exceeded that produced by the efforts of any other professor. The fervour of the teacher, his ardent love of nature, his eloquence, and the kindliness of his disposition, made an indelible impression upon his pupils, many of whom were anxious to devote their lives to the extension of their favourite science. Upsal became the centre of botanical, if not of zoological knowledge; and while students flocked to it from all parts of Europe, there were proceeding from it those whom we may call the devoted heroes of science, and who were resolved to enlarge its boundaries, by exploring regions previously unknown to the natural historian. An account of these men belongs in some measure to the life of their master, in which it will form an interesting episode.

The first of his pupils that embraced the opportunity presented by the Swedish East India Company, was a young man named TERNSTROEM, who in 1745 embarked for China. He died, however, at Pulicandor, before reaching the place of which he had intended to describe the productions, and thereby to secure for himself a scientific immortality.

In the summer of 1749, FREDERICK HASSELQUIST, another of his students, was induced by his representations to undertake a voyage to Smyrna, for the purpose of examining the natural treasures of Palestine. Private contributions were made to defray the expense of his journey, and a free passage was given in an East Indiaman. Next year he continued his course to Egypt, where he remained nine months, surveying the pyramids and other remarkable objects, and collecting all the information that he could obtain respecting minerals, plants, and animals. He communicated the result of his labours to his friends at home, and was admitted a member of the Royal Society of Upsal, and of the Stockholm Academy of Sciences. In March 1751, he left Cairo, and taking the route of Jaffa, travelled with a caravan of pilgrims to Jerusalem, where he remained some time. He then visited the river Jordan, Mount Tabor, Jericho, Bethlehem, Tyre, and Sidon, and embarked for Smyrna, where he arrived with a great variety of specimens illustrative of natural history, as also with a valuable selection of Arabic manuscripts, coins, and mummies. He was preparing to return to his native country, to enjoy the fruit of his toils, when he was seized with a violent affection of the lungs, the predisposition to which existed before he left Sweden, and

of which the symptoms had been aggravated by the fatigues and privations he endured in crossing the sandy deserts. The disease quickly assumed an alarming character, and he finally sunk under it on the 9th February 1752, in the thirtieth year of his age.

Hasselquist having contracted debts at Smyrna, his creditors seized his collections, and would have exposed them to sale, had they not been prevented by the Swedish consul, who sent home an account of the circumstances under which the youth had died. The queen, Louisa Ulrica, gave orders to redeem his property, which was accordingly transmitted to her, and deposited in the palace of Drottningholm, where she usually resided. Duplicates of the various articles were given to Linnæus, together with all the manuscripts, which were published in the Swedish language under the title of Iter Palæstinum. This work was afterwards translated into German, English, and French. It consists of two parts, the first of which contains the journal of the traveller and his correspondence; while the second is devoted to observations on mineralogy, botany, and zoology, as well as to many interesting subjects relating to the diseases, commerce, and arts, of the countries which had been visited. A Flora of Palestine, made up from the papers and specimens of Hasselquist, was afterwards published in the fourth volume of the Amænitates Academicæ.

Professor Michaelis of Gottingen, so well known for his proficiency in the languages of the East, having strongly enforced the propriety of obtaining a more extensive knowledge of those countries in which most of the events recorded in the Scrip-

tures took place, a society was instituted for that purpose; and through the influence of the Danish ministers, Counts Bernstorff and Moltke, an expedition was fitted out for Arabia. In 1761, five persons were chosen for conducting this enterprise, viz. Counsellor Niebuhr, Professor Forskal, a native of Sweden, Von Haven, Cramer, and Baurnfeind the painter. In June 1763, FORSKAL wrote to Count Bernstorff, communicating some information respecting the balsam of Mecca; but in about a month afterwards he fell a sacrifice to science, and died at Jerim. His companions suffered a similar fate, with the exception of Niebuhr, who on returning published an account of the journey. The observations of the naturalist were arranged by the same author, and appeared in 1775, accompanied with illustrative engravings. In a letter to Ellis, several years earlier, Linnæus mentions him thus:—"Mr Forskal, an excellent pupil of mine, just appointed professor at Copenhagen, is to be sent next year, at the expense of the King of Denmark, to the Cape of Good Hope and Arabia Felix. If God preserve him to us, we may expect a multitude of interesting discoveries. He excels more particularly in the knowledge of insects, although very well versed in the other branches of natural history." Niebuhr, who sent to him a copy of the posthumous work as soon as it was printed, was elected a member of the Stockholm Academy of Sciences, out of gratitude for the pains which he had taken to preserve the name of his unfortunate friend.

Application having been made to Linnæus, from Madrid, for an able botanist, he chose PETER LŒFLING, one of the most distinguished of his pupils,

who proceeded to Spain in 1751. During two years he continued to collect and describe the plants of that country. At the end of this period, he was sent by the government to travel through the different Spanish settlements in South America. He had explored the districts of Cumana, New Barcelona, and St Thomas of Guyana, and was preparing to extend his journey, when he was attacked by fever, and died in the twenty-seventh year of his age. The professor, who was much affected by the death of this zealous and enterprising youth, published an account of his travels, under the name of Petri Lœflingii Iter Hispanicum.

The next victim to the eager pursuit of knowledge was FALK, a native of West Gothland, who, coming to Upsal in 1751 to study natural history, was received by Linnæus into his house, and appointed to take charge of the education of his son. In 1759, he made a journey to Gothland, and afterwards went to Copenhagen, in the hope of being sent to Arabia along with Niebuhr and Forskal; but not finding his wishes gratified returned to college. In 1763, through the recommendation of his master, he was engaged by M. Kruse, first physician to the Emperor of Russia, to take charge of his cabinet of natural curiosities, and was proceeding to Petersburg when he suffered shipwreck at Narva. In 1765, he was appointed keeper of the botanic garden and professor of the medical college; but the assiduity with which he pursued his studies rendered him subject to a disease of the bowels, causing accessions of melancholy. In one of these fits of hypochondriasis he shot himself, at Casan in Tartary, on the night of the 20th March 1774.

Thus perished, in the midst of their career, five of the most promising pupils of Linnæus; but, not deterred by their fate, others pressed forward with the desire of distinguishing themselves.

The professor, knowing that a species of mulberry-tree grew in Canada, proposed to the Royal Society of Stockholm a voyage to that country, for the purpose of learning whether the plant in question could be naturalized in Sweden. The proposal being acceded to, he made choice of PETER KALM, one of the most promising of his students. In 1747, he departed for America, where he remained three years. In 1751, he returned to Abo, in Finland, where his patron had obtained a professorship for him, and published an account of his voyage. The Canadian mulberry-tree (*Morus rubra*) was in fact introduced by him into Sweden, and seems in some degree to have answered the purpose intended; but, although the government offered a premium for its cultivation, the silk-manufacture of that country has never succeeded. Kalm, after travelling in various parts of Russia, died at his own residence in 1790. His travels in America were translated into English by John Reinhold Forster, who accompanied Captain Cook on his second voyage.

Rolander embarked for Surinam in 1755; Toren, in 1750, for the coast of Malabar and Surat; and Osbeck for China in 1751. The journal of the latter was also translated by Forster. But the most distinguished among the more fortunate travelling-pupils of Linnæus were Sparrmann and Thunberg, the latter of whom became his successor in the university.

ANDREW SPARRMANN studied medicine at Upsal,

where, by his attention to natural history, he attracted the notice of the celebrated professor of that science. In 1765, he made a voyage to China with his cousin, Captain Ekeberg, who commanded a ship belonging to the East India Company, and who was also fond of similar studies. On his return, he described, in an academic thesis, the plants and animals which he had collected on this voyage. Having now formed a strong attachment to botany and zoology, he again became desirous of travelling; but his poverty would have prevented him had not his friend Ekeberg procured for him the office of tutor to the children of a person residing at the Cape of Good Hope, where he arrived in 1772. Soon after, he had the pleasure of meeting his countryman Thunberg, from whom, however, he was soon forced to separate; and in October made a journey to Paarl, on his return from which he occupied himself with a description of the plants indigenous to the district in which he resided. Captain Cook, on his second voyage, having arrived at the Cape, the two Forsters, who accompanied him as naturalists, went to see Sparrmann, and persuaded him to go along with them. This he was not loath to do, and, accordingly, had the pleasure of circumnavigating the globe. On revisiting the Cape, in July 1775, he subsisted by practising medicine, and in a short time acquired sufficient funds to enable him to undertake an excursion into the interior. He penetrated 350 leagues in a north-easterly direction, and returned with a large stock of plants and animals. The same year he revisited his native country, where he found that in his absence he had been promoted to the degree of Doctor in Medicine. He was now elected a member of the Royal

Society of Stockholm, and, after the death of Baron de Geer, was appointed conservator of his collection of natural history, which had been bequeathed to that body. Some time after, he was made president of the same learned institution,—an office which he resigned in three months. In 1787, he accompanied his friend Wadstroem on an expedition into the interior of Western Africa; but the project failed, and in the following year he returned to the Swedish capital, where he continued till his death in July 1820. The principal works which he published are, 1. A Voyage to the Cape of Good Hope, to the South Polar Circle, and round the Globe, with a Journey into the Country of the Hottentots and Caffres. This book has been translated into English. 2. The Musæum Carlsonianum, containing Descriptions of the rarer Animals in the Collection of Baron Carlson. 3. A Discourse on the Advantages of Expeditions to the Pacific Ocean, with Descriptions of Animals and Plants.

Charles Peter Thunberg was born in Sweden in 1743, and died at Upsal in 1828. In 1770, after finishing his education, he went to France, and from thence to Holland, where, on being recommended by Burmann, he was engaged by the Dutch East India Company to go to Japan in a medical capacity. After remaining some time at the Cape, he proceeded to his destination, and afterwards to Java and Ceylon, whence he returned first to England, and subsequently to Germany. His travels occupied nine years. Fourteen months after the death of Linnæus, he was appointed director of the botanic garden of Upsal during the absence of the son of that renowned professor. He acquired

the honours usually bestowed on fortunate cultivators of science, and finally succeeded the younger Linnæus.

Besides these celebrated individuals, who explored the most remote regions of the globe, many of the students trained in the garden and lecture-rooms of Upsal traversed various parts of Europe. Koehler visited Italy; Alstroemer the same country, as well as France and Spain; Von Troil made a voyage to Iceland; Fabricius travelled in Norway, England, and France; and Solander examined the Lapland Alps. In short, an astonishing impulse was given to the study of natural history in general, and of botany in particular. Facts and observations were accumulated to such a degree, that had Linnæus lived ten years longer he would have been utterly unable to continue the legislator of the science in all its departments.

To him, however, remains the glory of having been the only individual who described all the minerals, plants, and animals, known in his time. Before him no one had attempted the task.

SECTION VII.

Linnæus's Occupations from 1750 *to* 1770.

Publication of the Philosophia Botanica—General Account of that Work—Linnæus engaged in arranging the Collections of the Queen and Count Tessin—The Species Plantarum—Sir J. E. Smith's Remarks on it—Quotation from the Preface, with Remarks—Linnæus publishes improved Editions of his Works—Obtains Prizes for Essays from the Royal Societies of Stockholm and Petersburg—Is elected a Member of the Academy of Sciences of Paris—Receives Plants and Seeds from various Quarters—Purchases two Estates—Delivers private Lectures at his Museum—His Emoluments—His Son appointed his Assistant and Successor—He receives Letters of Nobility; and is rewarded for his Discovery of the Art of producing Pearls—His domestic Troubles, Infirmities, and sincere Reconcliliation to his old Antagonist Rosen, who attends him in his Sickness.

It has been already mentioned that Linnæus, when residing in Holland, printed a short treatise containing his theoretical views respecting the classification of plants. This work, to which he gave the title of Fundamenta Botanica, consisted of a series of aphorisms or propositions, which his friends afterwards repeatedly urged him to demonstrate at length, so as to constitute them into a body of doctrine which might be considered as the code of botanical science. Accordingly, in 1751, he published the Philosophia Botanica, one of the most remarkable performances that any age or country can boast of. It consists of 12 chapters, 52 sections, 365

aphorisms, in imitation of the different divisions of the year,—a puerile conceit, with which his enemies have not failed to taunt the illustrious author. Had there been a hundred days more he might have found aphorisms for them all; and any one conversant with zoology might engage to construct a classification of animals on the very same principle. Since he was so attached to numerical analogies, it is surprising that he did not form 12 classes of plants, 52 orders, 365 families, and a number of genera corresponding to that of the hours in a year. On such an arrangement might, with due calculation, have been founded a system of botany as perfect as any that had appeared before his time. The distribution of his materials, however, is the only childish part of the book; for in other respects it must be acknowledged to be a model of perspicuity, precision, and force.

The first chapter gives an account of the principal writers on botany; the second, of systems of classification; the third, of the roots, stems, and leaves of plants; the fourth, of the parts of fructification. In the remaining chapters are discussed the doctrine of sexes, the characters of the classes and subdivisions, the names of the genera, the specific differences, varieties, synonymes, the descriptions of the species, and the virtues or uses. At the end of the volume are several curious fragments, containing directions to students of botany, the method of forming herbariums, a plan to be followed by naturalists in travelling, and other matters of a like nature.

"The Genera Plantarum," says Linnæus in his private memoirs, "the most important of all the

works on botany, and which was intended for facilitating the study of that science, being completed, he laboured at the species. He was at this period the only person who had at his disposal the materials necessary for the composition of that great work. His herbarium was immense, and no one had seen so great a number of gardens and collections. With the assistance of this methodical book, any person can make out the plants already described by authors, and those which have become known only of late, or which are entirely new. He laboured two successive years at the species; and it was at this period that he felt the first attacks of calculus, the usual consequence of too sedentary a life, and of long-continued pressure on the lower abdominal viscera."

In 1753, being again called to Drottningholm, he was desired to describe the natural productions contained in the museums of his majesty and the Count Tessin. The former rewarded him with a valuable ring, the latter with a gold watch and a copy of Rumphius's splendid Herbarium Amboinense. But what delighted him most was the assurance given by the queen, that should his son evince a liking to natural history, she would send him to travel over Europe at her own expense.

This year appeared the Species Plantarum, which was published at Stockholm in two volumes, and contained the characters of 7000 species. Haller denominates this production "maximum opus et æternum." It is unnecessary here to offer any detailed account of it, as it is well known to every botanist. Sir James E. Smith, in his Life of Linnæus, observes, that "it is ever memorable for the

adaptation of specific, or, as they were at first called, trivial names. This contrivance, which he first used in his Pan Suecicus, a dissertation printed in 1749, extended to minerals in his Museum Tessinianum, and subsequently to all the departments of zoology, has perhaps rendered his works more popular than any one of their merits besides. His specific differences were intended to be used as names; but their unavoidable length rendering this impracticable, and the application of numeral figures to each species, in Haller's manner, being still more burthensome to the memory, all natural science would have been ruined for want of a common language, were it not for this simple and happy invention. By this means we speak of every natural production in two words, its generic and its specific name. No ambiguous comparisons or references are wanted, no presupposition of any thing already known. The distinguishing character of each object is mostly stamped in its name; and if this perfection of the art cannot always be attained, the memory is assisted, often very ingeniously, with collateral information, indicating the colour, the habit, or the qualities of the object of our examination. The philosophical tribe of naturalists, for so they are called by themselves and their admirers, do not therefore depreciate Linnæus when they call him a nomenclator. On the contrary, they celebrate him for a merit which no other person has attained, and without which their own discoveries and remarks, of whatever value, would not be understood."

In the preface to this work, which he dedicated to the king and queen, we find the following passage, which will enable the reader to form an estimate of

that kind of forbearance which he showed towards his critics:—"I have never sent back upon my enemies the shafts which they have hurled at me. The grins of the malicious, the ironies and attacks of the envious, I have quietly borne. They have always been the reward of the labours of great men; but nothing of all this can hurt a hair of my head. Why should I not tolerate the wretches, when I have been loaded with the praises of the most celebrated botanists, before whom they must bend in the dust. My age, my profession, and my character, prevent me from waging war with my opponents. I will employ the few years I have to live in making useful observations. In natural history, errors cannot be defended nor truths concealed. I appeal to posterity." The decision of posterity, however, may be as unjust as that of our contemporaries, and the former is in all cases of less importance to us than the latter, for it can in no degree benefit the author who relies upon it. And to show that Linnæus severely felt the censure of his opponents, we have only to refer to his private memoirs. His treatment of them seems to have been the effect of pride more than of magnanimity, although it appeared to belong to the latter. Rousseau, who greatly admired it, was heard to exclaim, "Would that I had imitated the Upsal professor! I should have gained some days of happiness and years of peace."

About this time also was published his description of the museum of Count Tessin, already alluded to, under the name of Musæum Tessinianum. Lœfling sent him plants from Spain, and similar accessions poured in from other quarters; but he

occasionally experienced a return of his complaints, which were relieved by the plentiful use of wild strawberries. His account of the king's museum appeared the following year.

Besides his ordinary occupations of lecturing and accompanying his pupils on their excursions into the country, he sent forth successively improved editions of several of his works, which he endeavoured to bring up to the level of his expanding knowledge. The Stockholm Academy having offered a prize, consisting of two gold medals, for the best essay on the means of improving Lapland, he composed a treatise on the subject, which received the approbation of that learned body. Although no regular cultivation could be applied to so dreary a region, he showed that considerable improvements might be made by introducing plants which grow in the mountainous districts of similar latitudes, and especially by planting trees suited to the climate. In 1759, the Imperial Academy of Sciences at Petersburg announced a premium for the best work on the confirmation or refutation of the doctrine of sexes in the vegetable kingdom. He wrote on this topic also, in which he established the fact by new and irrefragable arguments, and the reward was of course adjudged to him. The motto which he affixed to this tract was indicative of his prevailing passion: "Famam extendere factis."

The celebrity of his name now attracted pupils from many parts of Europe; obtained him admission into most of the distinguished learned societies; and rendered him an object of attraction to travellers. In 1762, he was elected a foreign member of the Academy of Sciences of Paris,—a circumstance of

which he was not a little proud. "It was," says he, "the greatest honour that could be conferred on a man of science, and hitherto no Swede had enjoyed it. The number of foreign members is limited to eight. The following are the names of the persons who were then invested with that dignity:—Morgagni, Bernouilli, Euler, Macclesfield, Poleni, Haller, Van Swieten, and Linnæus."

The botanic garden at Upsal received accessions corresponding to the increasing fame of its restorer, and was enriched by specimens or seeds transmitted from many remote regions; from Kamtschatka and Siberia, by Demidoff and Gmelin; from China, by several of his pupils; from Egypt, Palestine, Java, and the Cape of Good Hope, by Thunberg, Sparrmann, and others; from Canada, Pennsylvania, and Virginia, by Kalm and Gronovius; from Jamaica, by Dr Browne; and from South America, by Miller. A great quantity of African seeds came into his possession in the following singular manner:—Donati, a young Italian naturalist, had been sent to Egypt and the Levant, at the expense of the King of Sardinia. At Alexandria he fell in love with a young lady, the daughter of a Frenchman, and in order to forward his suit, allowed her brother to accompany him on his travels. The intended relative, however, robbed him of all his money and collections, and carried them to France. Not finding himself safe there, he embarked again for Constantinople; but being still unable to turn his stolen seeds to any account, he sent them to Linnæus, whose name he had often heard mentioned by Donati. Among the rare exotics which he procured was the tea-plant,

which his friend Ekeberg brought from China in 1763, and which had not been previously seen in Europe.

In 1758, he purchased for 80,000 dollars (above £2330 sterling) two estates, situated at the distance of about three miles from Upsal, to which he retired during the vacations, and where he spent the last ten years of his life. On an eminence, near the mansion at Hammarby, he erected a museum, in which he deposited all his collections. It was of an oblong form, and had a magnificent prospect over an extensive plain sprinkled with villages, the city of Upsal and the river Sala appearing at a distance, and the lofty mountains of Dalecarlia lining the horizon. Here he occasionally gave lessons to foreigners, and improved his various works.

These private instructions seem to have been a source of great emolument to him. They were confined chiefly to strangers, who used to lodge in the neighbouring villages of Honby and Edeby, and to whom he pronounced his lectures, not in the grave and solemn habit of a professor, but as a companion, frequently wearing his dressing-gown and a red fur cap, with a tobacco-pipe in his mouth. Lord Baltimore, governor of Maryland, having gone from Stockholm for the purpose of seeing him, was entertained with a discourse on natural history; for which he presented him with a splendid gold snuff-box, 100 ducats, and a superb piece of silver plate.

A pleasing picture of his manners and amusements is given by his pupil Fabricius, although, in one circumstance at least, his example may not be consi-

dered as commendable: "We were three, Kuhn, Zoega, and I, all foreigners. In summer we followed him into the country. In winter we lived facing his house, and he came to us almost every day in his short red robe-de-chambre, with a green fur cap on his head, and a pipe in his hand. He came for half an hour, but stopped a whole one, and many times two. His conversation on these occasions was extremely sprightly and pleasant. It consisted either of anecdotes relative to the learned in his profession with whom he got acquainted in foreign countries, or in clearing up our doubts, or giving us other kinds of instruction. He used to laugh then most heartily, and displayed a serenity and an openness of countenance, which proved how much his soul was susceptible of amity and good fellowship.

"Our life was much happier when we resided in the country. Our habitation was about half a quarter of a league distant from his house at Hammarby, in a farm-house, where we kept our own furniture and other requisites for housekeeping. He rose very early in summer, and mostly about four o'clock. At six he came to us, because his house was then building, breakfasted with us, and gave lectures upon the natural orders of plants as long as he pleased, and generally till about ten o'clock. We then wandered about till twelve upon the adjacent rocks, the productions of which afforded us plenty of entertainment. In the afternoon we repaired to his garden, and in the evening we usually played at the Swedish game of trisset in company with his wife.

"On Sundays the whole family usually came to

spend the day with us. We sent for a peasant who played on an instrument resembling a violin, to the sound of which we danced in the barn of our farm-house. Our balls certainly were not very splendid, —the company was but small, the music superlatively rustic, and no change in the dances, which were constantly either minuets or Polish; but, regardless of these defects, we passed our time very merrily. While we were dancing, the old man, who smoked his pipe with Zoega, who was deformed and emaciated, became a spectator of our amusement, and sometimes, though very rarely, danced a Polish dance, in which he excelled every one of us young men. He was extremely delighted whenever he saw us in high glee, nay, if we even became very noisy. Had he not always found us so, he would have manifested his apprehension that we were not sufficiently entertained."

The presents which he received from his admirers, the fees of his pupils, his salary, and the property which he had acquired by marriage, rendered him one of the richest of the Upsal professors; and, during the latter period of his life, his stated income was doubled by order of the king. The emoluments which he derived from his works were not great, as he got only for each printed sheet the small sum of one ducat, or about nine shillings and sixpence sterling.

To add to his happiness, his son, at the age of twenty-one, was appointed his assistant and successor, shortly after he himself had received letters of nobility, which were antedated four years. In 1748, Frederick I. had founded the order of the Polar

Star for men of merit in the civil line, and Linnæus was the first who was admitted into it by his successor, Frederick Adolphus. He proposed for his arms the three fields of nature, black, green, and red, surmounted by an egg, with the Linnæa for a crest; but the keeper of the great seal adopted a different arrangement. The Diet at the same time bestowed on him a reward of upwards of £520 sterling, for his discovery relative to the production of pearls; and it is even asserted that his elevation to the rank of nobility was not given on account of his botanical labours, or his general merits, but for this alleged discovery, which, however, has turned to no account.

But the interest which we have felt in the progress of this great man now begins to be less intense. He seems to us to have accomplished his destiny, and we prepare to trace his steps to the grave. In his domestic life he is supposed to have been subjected to many mortifications, arising from the parsimony and domineering temper of his wife. Long before this period, too, he had become subject to attacks of rheumatism, gravel, and gout; while his too-sensitive mind was harassed by the open as well as more insidious attacks of his opponents. It is pleasing to witness the reconciliation of enemies, and we have already remarked that Linnæus and his old antagonist Rosen were ultimately on the most friendly terms. "In 1764," says the private manuscript, "he was attacked by a violent pleurisy. He was anxiously attended by Dr Rosen, who saved him from certain death. From this time he conceived the most sincere affection for his brother-professor."

Before proceeding to convey the prince of naturalists to the tomb, it seems expedient to examine the most important of his numerous works,—that, namely, in which he arranges all the known objects of nature, and of which the last edition, brought out under his own inspection, appeared about this epoch of his life.

SECTION VIII.

Account of the Systema Naturæ of Linnæus.

Linnæus's Classification of the Animal Kingdom—Remarks on the Gradations employed, and on Nomenclature—Classification of the Animal Kingdom—General Remarks—Method of Tournefort—Method of Linnæus—Classification of the Vegetable Kingdom—Theory of the Formation of Minerals and Rocks.

THE work just mentioned bears the title of Systema Naturæ per Regna tria Naturæ, secundum Classes, Ordines, Genera, Species, cum Characteribus, Differentiis, Synonymis, Locis,—A System of Nature, in which are arranged the objects constituting the three kingdoms of nature, in classes, orders, genera, and species, with their characters, differences, synonymes, and places of occurrence.

The first volume contains the animal kingdom. The introduction presents a brief view of the constitution of the world, in the usually laconic style of the author. In it the three kingdoms of nature are thus defined:—*Minerals* are concrete bodies, possessing neither life nor sensibility; *vegetables* are organized bodies, possessed of life, but without sensibility; *animals* are organized bodies, possessing life and sensibility, together with voluntary motion. Objections may be made to these definitions; but it is not our object at present to criticise his views and arrangements, our inten-

tion being simply to offer a brief account of them, omitting all that is not absolutely essential. It ought to be understood, that the entire work is merely an index or catalogue of the productions of nature; that it was obviously intended as such by its author; and that they who object to the Systema Naturæ, because it contains nothing more than characteristic notes methodically arranged, forget that Linnæus never professed to give descriptions in it.

The natural division of animals, he says, is indicated by their internal structure. This principle his modern adversaries have chosen to overlook, asserting that his classification is founded on external form. In some species the heart has two distinct cavities, and the blood is warm and red; of these some are viviparous,—the *mammalia*,—others oviparous,—the class of *birds*. In certain species the heart has only a single cavity, with a single auricle, the blood red but cold; of these the *amphibia* have a voluntary respiration, while *fishes* respire by gills. In other animals the heart has also a single cavity, but without an auricle, while the blood is cold and of a white colour; of these the *insects* are characterized by their antennæ, the *vermes* or *worms* by their tentacula.

The *Mammalia*, which constitute the first class, are the only animals furnished with teats. Their clothing, hoofs, claws, horns, teeth, and other organs, are briefly described, in such a manner as to enable the student to comprehend the meaning of the terms to be subsequently employed. The characters of the orders are derived principally from the teeth.

I. PRIMATES or *Nobles:* Mammalia furnished with fore teeth, of which there are four in the upper jaw, and two pectoral mammæ.

II. BRUTA: No fore teeth in either jaw.

III. FERÆ, *Beasts of Prey:* The fore teeth conical, usually six in each jaw.

IV. GLIRES or *Gnawers:* Two chissel-shaped fore teeth in each jaw.

V. PECORA, *Cattle:* No fore teeth in the upper jaw, several in the lower.

VI. BELLUÆ: Fore teeth obtuse; feet furnished with hoofs.

VII. CETE, *Whales:* Pectoral fins in the place of feet, and in place of a tail the hind feet united so as to form a flat fin; no claws; the teeth cartilaginous.

The order *Primates* contains four genera:—

1. *Homo, Man,* of which (strange to say) he makes two species, viz. *Homo Sapiens,* including all the descendants of Adam, and *Homo Troglodytes,* the orang-outang! The varieties of the human race are the American, the European, the Asiatic, the African or Negro, and those called monstrous, such as the Patagonians, characterized by their great size, the flat-headed Indians of Canada, &c. His description of the human figure is amusing; and as it may afford an idea of his mode of viewing objects, we shall translate it in part:—

"The *Body* erect, bare, sprinkled over with a few distant hairs, and about six feet high. The *Head* inversely egg-shaped: scalp covered with longer hairs: the fore part obtuse, crown very obtuse, hind-head bulging. The *Face* bare: *Forehead* flattish, square, compressed at the temples, ascending at the corners among the hair. *Eyebrows* somewhat pro-

minent, with hairs closely set and directed outwards, separated by the flattish glabella. Upper *eyelid* moveable, lower fixed, both pectinated with projecting somewhat recurved hairs. *Eyes* round: pupil round, without nictitant membrane. *Cheeks* bulging, softish, coloured, their lower part somewhat compressed, the buccal portion looser. *Nose* prominent, shorter than the lip, compressed, higher and more bulging at the tip; nostrils ovate, hairy within, with a thickish margin. Upper *lip* nearly perpendicular, grooved in the middle; lower *lip* nearly erect, more prominent. *Chin* protruded, obtuse, bulging. *Mouth* in the male bearded with bristles, which on the chin especially form a bundle. *Fore teeth* in both jaws sharp edged, erect, parallel, close; *canine teeth* solitary, a little longer, close to the rest on both sides; *grinders* five, bluntish. *Ears* lateral; auricles roundish-semilunar, pressed in some measure towards the head, bare, vaulted above the margin; bulging and soft below." He then proceeds to state more particularly, that there is no tail, and that the thumb is shorter and thicker than the fingers. Man, therefore, differs from other animals, as he says, in having the body erect and bare, although the head and eyebrows are covered with hair, two pectoral mammæ, a brain larger than that of any other creature, a uvula, the face bare and parallel to the abdomen, the nose prominent and compressed, the chin projecting, no tail, feet resting on the heels, the males bearded on the chin, the females smooth.

As to the orang-outang, which forms his second species of man, he might have known that having four hands, and being incapable of carrying

its body erect, it had no right to stand beside the lord of the creation.

The second genus, *Simia*, includes the baboons and monkeys, of which, with and without tails, he enumerates thirty-three species.

3. *Lemur*, the macaucos: 5 species.
4. *Vespertilio*, the bats: 6 species.

These are the *Nobles* of the animal kingdom: men, monkeys, lemurs, and bats. There could hardly be a more unnatural association; but all artificial systems, founded upon the consideration of a single organ or set of organs, are chargeable with similar absurdities.

The second order, BRUTA, is composed of the following genera:—

5. *Elephas*, the elephant, of which there is only one species.
6. *Trichechus*, the walrus: 2 species, the morse and manati.
7. *Bradypus*, the sloth: 2 species.
8. *Myrmecophaga*, the ant-eater: 4 species.
9. *Manis*: 2 species.
10. *Dasypus*, the armadillo: 6 species.

The third order, FERÆ, or Beasts of Prey:—

11. *Phoca*, the seal: 3 species.
12. *Canis*, the dog, wolf, hyena, fox, jackal, &c.: 9 species.
13. *Felis*, the cat kind, including the lion, the tiger, &c.: 7 species.
14. *Viverra*, the civet: 6 species.
15. *Mustela*, the martin, including otters, weasels, ermines, polecats, &c.: 11 species.
16. *Ursus*, the bear: 4 species.

17. *Didelphis*, the opossum: 5 species.
18. *Talpa*, the mole: 2 species.
19. *Sorex*, the shrew: 5 species.
20. *Erinaceus*, the hedgehog: 3 species.

The fourth order, GLIRES, Gnawing Animals:—

21. *Hystrix*, the porcupine: 4 species.
22. *Lepus*, the hare: 4 species.
23. *Castor*, the beaver: 3 species.
24. *Mus*, rats and mice: 21 species.
25. *Sciurus*, the squirrel: 11 species.
26. *Noctilio*: 1 species.

The fifth order, PECORA, the Ruminating Animals:—.

27. *Camelus*, the camel, dromedary, lama, and alpaca: 4 species.
28. *Moschus*, the musk: 3 species.
29. *Cervus*, the deer: 7 species.
30. *Capra*, the goat: 12 species.
31. *Ovis*, the sheep: 3 species.
32. *Bos*, the ox tribe: 6 species.

The sixth order, BELLUÆ, contains,—

33. *Equus*, the horse, ass, and zebra: 3 species.
34. *Hippopotamus*: 1 species.
35. *Sus*, the hog tribe: 5 species.
36. *Rhinoceros*: 1 species.

The seventh order, CETE, the Whales, consists of four genera:—

37. *Monodon*, the narwhal, or sea-unicorn: 1 species.
38. *Balæna*, the whale, properly so called: 4 species.
39. *Physeter*, the cachalot: 4 species.
40. *Delphinus*, the dolphin: 3 species.

Including a few additional species mentioned in the appendix to the third volume, and the Mantissa of 1771, the number of Mammalia known to Linnæus was about 230. At the present day, more than 1000 species are described.

The second class, that of Birds, is divided by him into six orders, the essential characters of which are derived from the bill and feet, as follows:—

I. Accipitres: *Birds of Prey.* The bill more or less curved, the upper mandible dilated or armed with a tooth-like process near the tip; the feet short, robust, with acute hooked claws.

II. Picæ. The bill cultriform, with the back convex; the feet short, rather strong.

III. Anseres: *Web-footed Birds.* The bill smooth, covered with epidermis, enlarged at the tip; the toes united by a web, the legs compressed and short.

IV. Grallæ: *Waders.* The bill somewhat cylindrical; the feet long, bare above the knee, and formed for wading.

V. Gallinæ: *Gallinaceous Birds.* Bill convex, the upper mandible arched over the lower, the nostrils arched with a cartilaginous membrane. Feet with the toes separated, and rough beneath.

VI. Passeres: *Small Birds.* Bill conical, sharp pointed; feet slender, the toes separated.

It may here be remarked, that this arrangement is liable to many objections, and especially because the characters given to the orders are totally inapplicable to many species contained in them. Thus, the vultures, which belong to the first order, have no projecting processes on the upper mandible; the parrots, which are referred to the second, have the bill hooked, not cultriform, and bear no resemblance to the other spe-

cies; among the Anseres, which are characterized as having the bill smooth, covered with epidermis, and enlarged at the tip, are the gannet with a bare pointed bill, the divers, the terns, and the gulls, with bills not at all answering to the description given; among the Grallæ with a cylindrical bill, are the ostrich with a short depressed one, the boatbill with one resembling a boat, the spoonbill, the heron, the flamingo, and others, whose bills differ from each other as much as from that of the snipes and curlews; the character given to the bill of the Gallinæ agrees with that of many Passeres; and, lastly, the wagtail, the swallow, the tit, the robin, and a multitude of other small birds, have bills extremely unlike those of the goldfinch, bunting, and crossbill, which are referred to the same order. We mention these circumstances, not for the purpose of detracting from the merit of Linnæus, but simply because we are persuaded that many of his generalizations are extremely incorrect, as are in many respects those of all his predecessors, and even of the ablest philosophers of the present age. It is absurd to attempt to thrust the objects of nature into squares or circles, or enclosures of any other form. Every system that has been invented has failed in presenting even a tolerably accurate view of the discrepancies and accordances of the endlessly-diversified forms that have resulted from the creation of an Infinite Power.

The following table presents the Linnæan arrangement of Birds in outline:—

Order I. Accipitres.

41. *Vultur*, vultures. Beak hooked; head bare: 8 species.

42. *Falco*, eagles and hawks. Beak hooked; head feathered: 32 species.

43. *Strix*, owl. Beak hooked, feathers at its base directed forwards: 12 species.

44. *Lanius*, shrike. Beak straightish, notched: 26 species.

Order II. Picæ.

45. *Psittacus*, parrots. Beak hooked; upper mandible furnished with a cere: 47 species.

46. *Ramphastos*, toucan. Beak very large, hollow, convex, serrated; both mandibles incurved at the tip: 8 species.

47. *Buceros*, hornbill. Beak convex, curved, cultrate, large, serrated; forehead covered with a horny plate: 4 species.

48. *Buphaga*, beef-eater. Beak straight, somewhat quadrangular; the mandibles bulging: 1 species.

49. *Crotophaga*, plantain-eater. Beak compressed, half-eggshaped, arched, keeled on the back: 2 species.

50. *Corvus*, crows. Beak convex, cultrate; nostrils covered by recumbent bristly feathers: 19 species.

51. *Coracias*, roller. Beak cultrate, the tip incurved, not covered with feathers at the base: 6 species.

52. *Oriolus*, oriole. Beak conical, convex, straight, very acute; upper mandible slightly longer, and indistinctly notched: 20 species.

53. *Gracula*, grakle. Beak cultrate, convex, bareish at the base: 8 species.

54. *Paradisea*, birds of Paradise. Beak covered with the downy feathers of the forehead; feathers of the sides long: 3 species.

55. *Trogon*, curucui. Beak shorter than the head, cultrate, hooked, serrated: 3 species.

56. *Bucco*, barbet. Beak cultrate, laterally compressed, notched at the tip, incurved, opening to beneath the eyes: 1 species.

57. *Cuculus*, cuckoo. Beak roundish; nostrils with a prominent margin: 22 species.

58. *Yunx*, wryneck. Beak roundish, sharp pointed; nostrils concave: 1 species.

59. *Picus*, woodpecker. Beak angular, straight, the tip wedgeshaped; the nostrils covered with recumbent bristly feathers: 21 species.

60. *Sitta*, nuthatch. Beak awlshaped, roundish, straight: 3 species.

61. *Todus*, tody. Beak awlshaped, a little flattened, obtuse, straight, with spreading bristles at the base: 2 species.

62. *Alcedo*, kingsfisher. Beak three cornered, thick, straight, long: 15 species.

63. *Merops*, bee-eater. Beak curved, compressed, keeled: 7 species.

64. *Upupa*, hoopoe. Beak arcuate, convex, a little compressed, rather obtuse: 3 species.

65. *Certhia*, creeper. Beak arcuate, slender, acute: 25 species.

66. *Trochilus*, humming-bird. Beak slender, longer than the head, its tip tubular: 22 species.

Order III. Anseres.

67. *Anas*, swans, geese, and ducks. Beak lamellated at the margin, convex, obtuse: 45 species.

68. *Mergus*, merganser. Beak denticulate, cylindrical, the tip hooked: 6 species.

69. *Alca*, auk. Beak short, compressed, convex, furrowed; the lower mandible with a prominent angle: 5 species.

70. *Procellaria*, petrel. Beak a little compressed; the upper mandible hooked, the lower channelled and compressed at the tip: 6 species.

71. *Diomedea*, albatross. Beak straight; upper mandible hooked at the tip, lower abrupt: 2 species.

72. *Pelecanus*, pelican, gannet, shag. Beak straight, the tip hooked, unguiculate: 8 species.

73. *Plotus*, darter. Beak straight, sharp pointed, denticulate: 1 species.

74. *Phaeton*. Beak cultrate, straight, acuminate: 2 species.

75. *Colymbus*, diver. Beak slender, straight, sharp pointed: 11 species.

76. *Larus*, gull. Beak straight, cultrate, the tip a little hooked; the lower mandible with an angular prominence: 11 species.

77. *Sterna*, tern. Beak slender, nearly straight, acute, compressed: 7 species.

78. *Rynchops*, skimmer. Beak straight; upper mandible much shorter, lower abruptly terminated: 2 species.

Order IV. Grallæ, Waders.

79. *Phœnicopterus*, flamingo. Beak incurvated as if broken, denticulate; feet webbed: 1 species.

80. *Platalea*, spoonbill. Beak flattish, the tip dilated, rounded, and flat: 3 species.

81. *Palamedea*, screamer. Beak conical; the upper mandible hooked: 2 species.

82. *Mycteria*, jabiru. Beak acute; lower mandible trigonal, ascending; upper three cornered, straight: 1 species.

83. *Cancroma*, boatbill. Beak bulging; the upper mandible resembling a boat with the keel uppermost: 2 species.

84. *Ardea*, cranes and herons. Beak straight, acute, long, a little compressed, with a furrow from the nostrils to the tip: 26 species.

85. *Tantalus*, ibis. Beak long, slender, arcuate; face bare: 7 species.

86. *Scolopax*, snipes, curlews. Beak long, slender, obtuse; face feathered: 18 species.

87. *Tringa*, sandpiper. Beak roundish, as long as the head; nostrils linear; feet with four toes: 23 species.

88. *Charadrius*, plover. Beak roundish, obtuse; feet with three toes: 12 species.

89. *Recurvirostra*, avoset. Beak slender, recurved, pointed, the tip flexible: 1 species.

90. *Hæmatopus*, oystercatcher. Beak compressed, the tip wedgeshaped: 1 species.

91. *Fulica*, coot. Beak convex; upper mandible arched over the lower, which has a prominent angle: 7 species.

92. *Parra*, jacana. Beak roundish, bluntish; forehead wattled; wings spurred: 5 species.

93. *Rallus*, rail. Beak thicker at the base, compressed, acute: 10 species.

94. *Psophia*, trumpeter. Beak conical, convex, rather sharp; the upper mandible longer: 1 species.

95. *Otis*, bustard. Beak with the upper mandible arched: 4 species.

96. *Struthio*, ostrich and cassowary. Beak somewhat conical; wings unfit for flying: 3 species.

Order V. GALLINÆ, Gallinaceous Birds.

97. *Didus*, dodo. Beak contracted in the middle, with two transverse rugæ; the tip of both mandibles bent inwards: 1 species, now extinct.

98. *Pavo*, pea-fowl. Head covered with feathers; feathers of the rump elongated, with eyelike spots: 3 species.

99. *Meleagris*, turkey-fowl. Head covered with spongy caruncles; the throat with a longitudinal membranous wattle: 3 species.

100. *Crax*, curassow-bird. Beak with a cere at the base; head covered with recurved feathers: 5 species.

101. *Phasianus*, pheasant. Sides of the head bare: 6 species.

102. *Numida*, Guinea-fowl. Carunculated wattles on each side of the face; head with a horny crest: 1 species.

103. *Tetrao*, grouse and partridge. A bare papillar spot near the eyes: 20 species.

Order VI. Passeres.

104. *Columba*, pigeon. Beak straight; nostrils with a tumid membrane: 40 species.

105. *Alauda*, lark. Beak slender, pointed; tongue slit; hind claw very long: 11 species.

106. *Sturnus*, starling. Beak slender, flattened towards the point: 5 species.

107. *Turdus*, thrush. Beak tubulate, compressed, notched: 28 species.

108. *Ampelis*, chatterer. Beak awlshaped, depressed at the base, notched: 7 species.

109. *Loxia*, grossbeak. Beak conical, bulging at the base: 48 species.

110. *Emberiza*, bunting. Beak somewhat conical; lower mandible broader: 24 species.

111. *Tanagra*, tanager. Beak notched, awlshaped, conical at the base: 24 species.

112. *Fringilla*, finch. Beak conical, acute: 39 species.

113. *Muscicapa*, flycatcher. Beak notched, awlshaped, with large bristles at the base: 21 species.

114. *Motacilla*, wagtails, warblers. Beak awlshaped, tongue jagged; claw of the hind toe of moderate length: 49 species.

115. *Pipra*, manakin. Beak awlshaped, incurved: 13 species.

116. *Parus*, tit. Beak awlshaped, feathers at its base directed forwards; tongue abrupt: 14 species.

117. *Hirundo*, swallow. Beak very small, depressed at the base, incurved; the mouth wider than the head: 12 species.

118. *Caprimulgus*, goatsucker. Beak very small, incurved, depressed at the base; large bristles; the mouth very wide: 2 species.

The class of Birds comprehends 930 species, which are characterized by the colours of the plumage, the forms of the feathers, the existence of wattles, spurs, and various other circumstances.

The third class, AMPHIBIA, is composed of animals not, strictly speaking, capable of living both in air and in water, but having the power of suspending their respiration in a more arbitrary manner than others. They are arranged under four orders:—

I. REPTILES. Amphibious animals respiring through the mouth by means of lungs; and furnished with four feet.

To this order belong the tortoises, dragons, crocodiles, lizards, toads, and frogs, which are disposed into four genera, containing 83 species.

II. SERPENTES, *Serpents.* Respiring through the mouth by means of lungs; destitute of feet, fins, and ears.

There are six genera, and 132 species.

III. MEANTES, *Gliders.* Respiring by means of gills and lungs; furnished with feet and claws.

There is only one species, the lizard-syren of Carolina.

IV. NANTES, *Swimming Amphibia.* Respiring at will by means of gills and lungs: the rays of the fins cartilaginous.

These animals, of which 76 species are enumerated, are referred to fourteen genera,—the lamprey, ray or skate, shark, chimæra, frog-fish, sturgeon, lump-fish, oldwife-fish, bonyskin-fish, sun-fish, porcupine-fish, trumpet-fish, pipe-fish, and dragon-fish.

The number of species described as belonging to this class is 292. The specific characters are derived from various circumstances connected with the external conformation; in the tortoises, from the shell and feet; in the snakes, from the number of the abdominal and caudal plates; in the swimming amphibia, or, as they are now more properly called, the cartilaginous fishes, from the form of the body, the differences of the fins, and other circumstances.

The fourth class, that of FISHES, contains four orders, founded upon the relative position of the fins, which are compared to the feet of other animals. Thus, the ventral fins may be placed before, beneath, or behind the pectoral, or they may be wanting.

I. APODES, *Apodal or Footless.* Fishes destitute of ventral fins; such as the eel, the wolf-fish, and the sword-fish.

II. JUGULARES, *Jugular.* Fishes having the ventral fins placed before the pectoral; as the dragonet, weever, cod, haddock, and coal-fish.

III. THORACICI, *Thoracic.* Fishes having the ventral fins placed under the pectoral; as the goby, bull-head, holibut, gilt-head, perch, mackerel, &c.

IV. ABDOMINALES, *Abdominal.* Fishes having the ventral fins placed on the abdomen behind the pectoral fins; as in the salmon, trout, pike, mullet, and herring.

In this class there are 47 genera, and 400 species. The specific characters are taken from the number of rays in the fins, the form of the tail, the cirri or filaments at the mouth, the colouring of the body, the form of the scales, and other circumstances.

The fifth class, that in which the INSECTS are included, comprehends 86 genera, disposed into seven orders, which are founded on the number and texture of the wings.

I. COLEOPTERA, or *Hard-winged Insects.* Insects having the wings covered by two crustaceous cases. This order is the most extensive, including 30 genera, and 893 species. It includes all the insects commonly known by the name of beetles.

II. HEMIPTERA, or *Half-winged Insects,* having the shells or cases semicrustaceous, not divided by a straight line as in the coleoptera, but overlapping each other at the margin; the beak curved inwards; 12 genera, 353 species. The cockroach, cricket, locust, and cochineal-insect, are examples.

III. LEPIDOPTERA, or *Scaly-winged Insects,* having four wings, which are covered with imbricated scales; the tongue spiral and coiled up, the body hairy. In this order there are only 3 genera, *Papilio, Sphinx,* and *Phalæna,* the butterflies and moths; but the species are 780.

IV. NEUROPTERA, or *Net-winged Insects,* with four naked, transparent, or reticulated wings; the tail generally destitute of a sting. There are 7 genera, and 88 species, among which are the dragon-fly, the may-fly, and the scorpion-fly.

V. HYMENOPTERA, or *Thin-winged Insects,* with four naked membranous wings; some species, however, being wingless. The females have the tail armed with a sting. This order contains 10 genera, and 313 species, of which may be mentioned as examples, the wasp, bee, ichneumon-fly, and ant.

VI. DIPTERA, or *Two-winged Insects,* having only two wings, and being furnished with a balance or club behind each wing. There are 10 genera, and 262 species, among which are the common house-fly, the flesh-fly, and the gnat.

VII. APTERA, *Wingless.* Insects destitute of wings in both sexes. They are arranged under 14 genera, and consist of 300 species. In this order there are three divisions: some have six feet, as the flea, the louse, and the white ant; others have from 8 to 14 feet, as the spider, scorpion, crab, and lobster; while others have a still greater number, as the centipede.

The generic characters are derived from the antennæ, the jaws, the head, the thorax, the wings, the elytra or wing-covers; and the specific, from the colours and other circumstances. The number of species is 2984.

The sixth class, that of VERMES or WORMS, is a very heterogeneous one, and to later authors has supplied materials for several classes. Linnæus divides it into five orders:

I. INTESTINA, *Intestinal Animals:* simple, naked, and destitute of limbs: for example, the earth-worm, the guinea-worm, the leech, and the ascaris: 7 genera, 24 species.

II. MOLLUSCA. Simple, naked animals, furnished with limbs: the slug, the sea-mouse, the sea-anemone, the cuttle-fish, the sea-nettle, the star-fish, and the sea-urchin: 18 genera, 110 species.

III. TESTACEA, *Shell-fish.* Soft, simple animals, covered with a shell which is usually calcareous. This order includes 36 genera, and 814 species. It is divided into three groups, the multivalve shells, or those which consist of several pieces; the bivalve, of two pieces; and the univalve, or those of one piece only.

IV. LITHOPHYTA. Compound animals, affixed to, and fabricating a fixed calcareous base, called coral. There are 59 species, which are referred to 4 genera, the tubipores, madrepores, millepores, and cellepores.

V. ZOOPHYTA. Compound animals, sending forth pro-

cesses resembling flowers, and springing from a vegetating stem. This order contains 15 genera, among which are the red coral, the sea-fan, the sponge, coralline, &c. The number of species is 156.

The characters of the genera and species of these orders are derived from so many various circumstances, that it would be tedious to recapitulate them. The number of objects defined in this part of the Systema Naturæ, is as follows :—

Mammalia,.....219	Insects,.....2984
Birds,.....930	Vermes,.....1163
Amphibia,.....292	Species from the
Fishes,.....400	Appendices,... 140

In all, 6128 species of animals.

It may be observed with respect to the method followed by Linnæus in his arrangements, that he has generally chosen the most simple and perspicuous that he could devise. The whole creation he disposes into three *kingdoms*, the animal, the vegetable, and the mineral. The animal kingdom is divided into six great *classes*, characterized by various circumstances of their organization. Each of these six classes is divided into several *orders* and numerous *genera*; and the genera are composed of *species*. Sometimes the species exhibits *varieties*, or variations of form, colour, and other qualities, dependent upon climate, food, domestication, and other circumstances. There are thus in his arrangement of animals five gradations: kingdom, class, order, genus, and species. We shall find that the same series is adopted in his classification of the vegetable kingdom. It must be remarked, however, that in nature none

of these gradations actually exist. Individuals alone form the subjects of observation; but a number of individuals closely resembling each other are considered in the mind as forming a species; and several species agreeing in certain respects with each other form a genus; while genera united by particular characters compose an order; and the orders constitute a class. Thus all the individual birds called goldfinches form the species *Goldfinch*, which with the species *Chaffinch* and others constitute the genus *Finch*. This genus, and those known by the names of *Grossbeak*, *Bunting*, *Lark*, &c. constitute the order *Passerine Birds*. Natural objects may thus be arranged in a definite series, so that the place of any given species may be determined; hence, if the student should be desirous of finding the name and history of a particular object, he can readily discover it, or he can satisfy himself that it has not yet been described. At the same time, it must be remembered, that the classification in question is entirely artificial, and does not necessarily place together genera that are the most closely allied. It is a kind of systematic index to the works of nature, and is useful in many respects, although it may not lead to the disclosure of all the peculiarities or all the affinities and relations of the object to be examined. The Linnæan arrangement of animals cannot be considered in any other light; for, if we view it as a natural classification, we meet with false positions and erroneous views at almost every step. His disciples mistook it for a perfect system, and viewed the various species with reference to it, rather than with respect to their mutual relations. Still, they who look upon the artificial clas-

sifications of our great master as having done more harm than good, judge erroneously; for although they are certainly imperfect, without them or others of a similar kind it would have been impossible to retain any distinct remembrance of the numerous objects which have successively been introduced to notice. It were more reasonable to admire the ingenuity displayed in the construction of so simple a system, than to blame the unsuccessful attempt to classify, according to their essential peculiarities, objects whose multiplied relations have, to the present day, defied the most accomplished naturalists.

With respect to the nomenclature, it is sufficient to remark, that the classes and orders bear appropriate names, derived from various circumstances. Thus in the class *Mammalia*, so denominated because the animals composing it bear mammæ and suckle their young, are the orders *Primates* or Nobles, *Bruta*, *Feræ*, &c. The generic names are always substantives, as *Phoca*, *Canis*, *Lepus*, &c.; and the specific names are either adjectives, as *Phoca barbata*, *Canis familiaris*, *Lepus timidus*, or, in certain rarer cases, substantives, as *Canis Lupus*, *Ursus Arctos*, &c. We now proceed to the examination of another kingdom.

The second volume of the Systema Naturæ contains an arrangement of all the species of vegetables known to Linnæus. It is in this department that our author has been generally allowed to excel, and his system, after undergoing some modifications, remains in use at the present day; nor is it likely ever to be superseded by any other merely artificial arrangement.

Before proceeding to a general account of this ce-

lebrated scheme, it may be useful to take a brief view of those by which it was preceded. It is obvious, that without a methodical disposition of plants, and a fixed nomenclature, it would be impossible for an individual to retain the knowledge of the numerous and diversified forms which these present. Descriptions, moreover, would be unintelligible, and we should find it difficult or impracticable to ascertain the species of which authors might write.

The alphabetical arrangement of plants, the most artificial, or at least the most unnatural of all, was at one time much followed by botanists, especially in local catalogues. The time of flowering, the place of growth, the general habit or appearance, and various other circumstances, formed a basis to other arrangements. In the sixteenth century, Conrad Gesner showed that the flower and fruit were the only parts capable of affording determinate characters. Cæsalpinus, physician to Pope Clement VIII., presented the first model of a botanical system, in his *Libri de Plantis*, published in 1583. The characters are derived principally from the fruit, though likewise from the flowers, and the duration of plants. The two Bauhins, Ray, and Morison, published systems constructed on similar principles. Others, as Rivinus and Ludwig, derived their characters from the corolla. All these methods, however, successively passed into neglect, and were superseded by that of Tournefort, who was professor of botany at the Garden of Plants in Paris, in the reign of Louis XIV. This eminent writer was the first who defined the species and genera with any degree of precision. He arranged plants ac-

cording to the various forms of the corolla, dividing them primarily, according to the consistence of the stem, into *Herbs* and *Trees*. The former were subdivided into three orders; those with simple flowers, those with compound flowers, and those destitute of flowers. The following is an outline of his system:—

Division I. HERBS.

* *With simple flowers.*

Corolla of one piece, regular.

Class I. CAMPANIFORMES, with a regular corolla, of one piece, and resembling a bell; as the convolvulus.

II. INFUNDIBULIFORMES, with a regular corolla, of one piece, and resembling a funnel; as the tobacco.

Corolla of one piece, irregular.

III. PERSONATÆ, with an irregular corolla, of one piece, resembling an antique mask; as the foxglove.

IV. LABIATÆ, with an irregular corolla, of one piece, divided into two lips; as the sage.

Corolla of several pieces, regular.

V. CRUCIFORMES, with a regular corolla, composed of four petals, placed crosswise; as the wallflower.

VI. ROSACEÆ, with a regular corolla, composed of several petals, arranged in the form of a rose; as the wild rose and apple.

VII. UMBELLIFERÆ, with a regular corolla, composed of five petals, the flowers arranged on stalks resembling the spokes of an umbrella; as in the carrot.

VIII. CARYOPHYLLEÆ, with a regular corolla, composed of five petals, having long claws; as the pink.

IX. LILIACEÆ, with a regular corolla, composed of six or three petals, or sometimes of one piece with six divisions; as the tulip.

Corolla of several pieces, irregular.

X. PAPILIONACEÆ, with an irregular corolla, composed of five petals; as the pea.

XI. ANOMALÆ, with an irregular corolla, composed of five petals, but differing from the papilionaceous form; as the violet.

* * *With compound flowers.*

XII. FLOSCULOSÆ, with flowers composed of small funnel-shaped, regular corollas, divided into five segments; as the thistle.

XIII. SEMIFLOSCULOSÆ, with flowers composed of small irregular corollas, of an elongated flat shape; as the dandelion.

XIV. RADIATÆ, with flowers composed of funnel-shaped florets at the centre, and flat ones at the circumference; as the daisy.

* * * *Destitute of flowers.*

XV. APETALÆ, whose flowers have no true corolla; as the grasses.

XVI. APETALÆ, entirely destitute of flowers, but having leaves; as the ferns.

XVII. APETALÆ, without apparent flowers or fruit; as mosses.

Division II. TREES.

Without petals.

XVIII. APETALOUS *Trees* or *Shrubs*, having their flowers destitute of corolla; as the box.

XIX. AMENTACEÆ, with the flowers disposed in catkins; as the oak.

With flowers of one petal.

XX. TREES with a regular or irregular corolla of one piece; as the lilac.

With regular flowers of several petals.

XXI. TREES or *Shrubs* with rosaceous corolla; as the apple-tree.

With irregular flowers of several petals.

XXII. TREES or *Shrubs* with papilionaceous corolla; as the laburnum.

Each of these classes is subdivided into various sections or orders, founded upon modifications in the form of the corolla, the nature of the fruit, the figure of the leaves, &c. The sections contain a greater or less number of genera, under which are disposed all the species known to the author.

This classification was of the greatest service to botanists; though it was, like every other method that had been proposed, defective in many respects. A great objection to it is, that it separates the herbaceous from the woody plants, thus tearing asunder the most natural connexions; nor is the form of the corolla always so determinate, that one can say whether it be bell-shaped, funnel-shaped, or salver-shaped,—a point which it is necessary to decide before the species can be made out. Various changes were soon proposed, and new methods planned, so that the science was again falling into confusion, when Linnæus published his system, which was presently adopted by many teachers, and long before his death was in general use.

He made the stamina and pistils the basis of his arrangement, which he was induced to do from the consideration of their great importance, as the parts most essential to fructification. These organs being analogous to those distinguishing the sexes of animals, the Linnæan method is sometimes called the sexual system. It consists of twenty-four classes. The first ten are determined by the number of the stamina.

Class I. MONANDRIA, containing all plants of which the flowers have only one stamen; as the mare's tail.

II. DIANDRIA: two stamens; as the jasmine.

III. TRIANDRIA: three stamens; as wheat, oats, and grasses in general.

IV. TETRANDRIA: four stamens; as woodruff.

V. PENTANDRIA: five stamens; as the primrose.

VI. HEXANDRIA: six stamens; as the lily and tulip.

VII. HEPTANDRIA: seven stamens; as the horse-chestnut.

VIII. OCTANDRIA: eight stamens; as the heaths.

IX. ENNEANDRIA: nine stamens; as rhubarb.

X. DECANDRIA: ten stamens; as the pink.

In the next three classes, the stamens exceed ten in number, but differ from each other in certain circumstances.

XI. DODECANDRIA: stamens from twelve to twenty; as in agrimony.

XII. ICOSANDRIA: twenty or more stamens, inserted upon the inner side of the calyx; as in the rose and apple.

XIII. POLYANDRIA: twenty or more stamens, inserted upon the receptacle or point of union of all the parts of the flower; as in the crowfoot and anemone.

The relative length of the stamens determines the next two classes.

XIV. DIDYNAMIA: four stamens, of which two are shorter; as in thyme and foxglove.

XV. TETRADYNAMIA: six stamens, of which two are shorter; as in cabbage and wallflower.

Three classes are indicated by having the stamina connected by their filaments.

XVI. MONADELPHIA: stamens united by their filaments into a single body or set; as in mallows.

XVII. DIADELPHIA: stamens united into two distinct sets; as in fumitory.

XVIII. POLYADELPHIA: stamens united into three or more bundles; as in hypericum and cistus.

In the next class, the stamens are united by their anthers.

XIX. SYNGENESIA: five stamens united by the anthers; as in the dandelion and violet.

In the twentieth, the pistil and stamen are united.

XX. GYNANDRIA: stamens united to the pistil; as in orchis.

The plants of all the above classes have flowers furnished with both stamens and pistils; but in the next three the flowers are unisexual.

XXI. MONŒCIA: Flowers bearing stamens only, and flowers bearing pistils only, occurring on the same plant; as in the oak.

XXII. DIŒCIA: stameniferous flowers on one, and pistilliferous flowers on another individual of the same species; as in willows.

XXIII. POLYGAMIA: Flowers bearing stamens and pistils, flowers bearing stamens only, and flowers bearing pistils only, all on the same individual, or on different individuals of the same species; as in the ash and pellitory.

The above classes contain all the plants that are *Phœnogamous*, or have distinctly perceptible organs of reproduction; the next and last class is composed of the *cryptogamous*, or those of which the flowers either do not exist, or have not been demonstrated.

XXIV. CRYPTOGAMIA: Ferns, mosses, lichens, sea-weeds, mushrooms, &c.

The orders or subdivisions of the classes are founded on the number of the pistils in the first thirteen. Thus, in any of these classes, the first

order is *Monogynia,* or one pistil; the second *Digynia,* two pistils, &c. But in the fourteenth class, Didynamia, there are only two orders, *Gymnospermia* and *Angiospermia,* the former having four naked seeds, the latter having the seeds enclosed in a seed-vessel. In the fifteenth class, Tetradynamia, there are also two orders, *Siliculosa,* in which the pod is short, and *Siliquosa,* in which it is long. The orders of Monadelphia, Diadelphia, and Polyadelphia, are formed from the number of the stamina, and bear the names of *Hexandria* when there are six, *Decandria* when there are ten, &c. The orders of the nineteenth class, Syngenesia, are six. In the first, *Polygamia æqualis,* all the flowers (or *florets,* as they are here called on account of their small size, and because they are viewed as components of a compound flower) have stamens and pistils, and are equally fertile; in the second, *Polygamia superflua,* the flowers of the centre have stamens and pistils, those of the circumference pistils only, but both kinds produce seeds; in the third, *Polygamia frustranea,* the flowers of the centre have stamens and a pistil, and are fertile, those of the circumference neutral, or furnished with a pistil, but steril; in the fourth, *Polygamia necessaria,* the flowers of the centre have stamens and a pistil, but are steril, in consequence of an imperfection in the stigma, those of the circumference have a pistil, and are fertile; in the fifth, *Polygamia segregata,* all the flowers are perfect, but each has a small calyx, and the whole are contained within a common involucre; and in the last order, *Monogamia,* the flowers are separated from each other. In Gynandria, the orders are determined by the number of the stamens. In

Monœcia and Diœcia, the characters distinctive of the classes are employed for the orders. Polygamia has three orders, *Monœcia, Diœcia, Triœcia;* and the last class, Cryptogamia, is divided into four orders, consisting of the *Filices* or Ferns, the *Musci* or Mosses, the *Algæ*, and the *Fungi*.

The genera are established upon characters derived from all the parts of fructification compared together, according to their number, figure, proportion, and situation; but as this volume was intended to contain all the plants known to the author, the *natural* characters thus formed could not be employed on account of their length, and he has used the *essential* character, which is shorter, and consists of those marks that serve to distinguish the genera from each other in the natural orders; while at the head of each class, the genera are synoptically disposed, being defined by their *factitious* characters, or those by which one is distinguished from another in the artificial order only.

The remarks which we have already made respecting the generic and specific names, apply equally to this department. These last, in the systems of former botanists, were lengthened descriptions, taken from various circumstances, and seldom in any degree distinctive; but Linnæus reduced them to twelve words at most, and derived them from some remarkable difference in the leaves, roots, stems, or other unvarying properties. These short phrases he continued to call the specific name, but they are now properly considered as the specific character; while he invented what he called the *trivial* name, consisting of a single word added to the generic, and which we now use as the specific.

The number of species mentioned in the Systema Naturæ amounts to upwards of 7800.

We come now to the third and last volume, containing his arrangement of the objects forming the mineral kingdom. This department has received less elucidation from him than the others. In 1736, he first digested a mineralogical system, in which he attempted to found the genera on definite characters; but he seems to have lost sight of the subject until obliged to attend to it when editing the twelfth edition of his work. There he prefixes to his arrangement a brief account of his theory on the origin of fossil bodies in general, and of their several combinations. His views, however, are extremely fanciful, and cannot be said to have produced any beneficial effect on the study of this science. As they have long ago passed into oblivion, it may afford amusement, if not instruction, to present an outline of them.

The earth originated from water, agreeably to the testimony of Moses, Thales, and Seneca! The sea becoming pregnant gradually produced the dry land, from which the dew rose by evaporation, was elevated into clouds, and again descended in showers. No certain indications of a universal deluge have yet been found, but we every where perceive that land has been formed from the sea.

The water of the ocean, being impregnated by the air, produces a twin birth; the *saline* principle, which is masculine, soluble, acrid, transparent, and crystalline; the *earthy*, which is feminine, fixed, viscid, opaque, and attractive. It also nourishes the animal and the vegetable beings, which in course of time are reduced to earth.

The *salts*, which are sapid, polyhedral, transparent, multiplicative, soluble into infinitely minute particles, although always retaining the same form, and again becoming concrete so as to form larger particles of the same figure, generate various minerals by crystallizing.

Nitrum, which is aerial, by covering over increases *sand*.

Muria, which is marine, by corroding attracts *clay*.

Natrum, which is of animal origin, by deliquescing coagulates *lime*.

Alumen, which is of vegetable origin, by ramifying produces *earthy soil*.

These are the *Fathers* of minerals.

The *Earths*, which are powdery, drying, soluble, fixed, primitive, are generated or reproduced by crystallizing, precipitating, fermenting, or putrefying. From them, by crystallization or attraction, minerals are reformed, and these again are resolved into earths and regenerated.

Clay is the precipitation of the viscid water of the sea; and is opaque, plastic, friable, capable of hardening, and fireless.

Sand is the crystallization of turbid rain-water; and is transparent, juiceless, giving sparks, durable, and capable of being vitrified.

Mould is the decomposition of fermenting vegetables; and is black, bibulous, powdery, and combustible.

Lime is the decomposition of putrescent animal substances; and is whitish, absorbent, mealy, penetrable, and effervescent.

Clay, the earth of sea-water, is hardened into *talc*, when redissolved is regenerated in the form of *as-*

bestus, and when more intimately dissolved resumes the form of *mica*. Sand, the earth of rain-water, when thrown on the land and dried, forms *drift-sand*, which finally becomes *gravel*. Both substances, when under ground, are converted into *sandstone*, and when mixed with other matters form *pebbles*, which grow into *stones*. When redissolved and crystallized, it produces *quartz*. *Mould*, the earth of vegetables, is hardened into fissile slate, which being impregnated with bitumen becomes *coal*. It is dissolved into *ochre*, and regenerated into *tophus*. Lime, the wife of natron, produces *marble*, dissolved and saturated with acid is crystallized into *gypsum*. Both are decomposed by the elements into *chalk*, which, acted upon by rain-water, becomes *flint*; and when dissolved, is crystallized into *spar* (or *calcedony*).

Such are the *Mothers* of minerals.

It is unnecessary to follow our author, while he states the principles of his sexual system of minerals, through the forms and modifications of crystals, metals, rocks, and petrifactions. His scheme of geology may be described as follows:—The strata of the earth are generally parallel to each other, although not always so, nor always of marine origin. The lowest is of sandstone (*cos*), the second of slate, the third of marble filled with marine petrifactions, the fourth of slate, the uppermost of the saxose kind, which includes granite, porphyry, trap, conglomerate, and puddingstone. It is obvious that the ocean has produced the land. It is rendered turbid by nitrous showers, precipitates, and is crystallized into sand, which covers the bottom of the sea. The surface of it is here and there covered over to a great

extent with floating fuci, the mould derived from which gradually descends, while the lighter particles help to form a floating meadow. Marine vermes, the mollusca, testacea, lithophytes, and zoophytes, together with fishes and sea-birds, feed beneath this floating meadow. An argillaceous sediment falls down in the quiet water, and this, together with the calcareous shells of the marine vermes, gradually forms a heap, which rises to the surface, while the pressure agitating the water drives out the marine animals. On the rock thus formed, the sea casts up great quantities of fuci, which are converted into mould, until at length the sandy earth rises above the surface, dries, is driven about, and concresces into gravel and sandstone. In the course of ages, the sand is hardened into sandstone, the mould into bituminous shale and coal, the clay into marble, other layers of mould into other beds of shale or slate, and other masses of sand into gravel and conglomerate. This again is converted into pebbles, these into stones, the stones into rocks. At length, the water subsiding, the mass becomes a mountain. Had Linnæus been as unfortunate in his other theories as in this, his name would have been long ago forgotten.

However fanciful his theoretical views may be, his classification is not unworthy of praise, and his specific definitions are generally intelligible to a modern mineralogist; but this is nearly all, however, that can be said in their favour. He divides the mineral kingdom into three classes, under the names of *Petræ*, *Minerœ*, and *Fossilia*. These are again subdivided into several orders, and the number of genera amounts to fifty-four.

Class I. PETRÆ or STONES, or, as modern geologists would say, ROCKS.

Steril stones, originating from an earthy principle by cohesion; simple, as being destitute of salt, sulphur, or mercury; fixed, as not being intimately soluble; similar, as consisting of particles united at random.

Order I. HUMOSÆ. Deposited from vegetable earth, combustible and burning to cinders, their powder harsh and light; as roofing-slate.

Order II. CALCARIÆ. Originating from animal earth; penetrable by fire, and becoming more porous, their powder mealy; and when burnt, they fall into a fine powder; as limestone, marble, gypsum.

Order III. ARGILLACEÆ. Originating from the viscid sediment of the sea, becoming harder and stiffer in the fire, their powder unctuous before exposure to fire; as serpentine, asbestus, mica.

Order IV. ARENATÆ. Originating from precipitation caused by rain-water, when struck with steel emitting sparks, very hard, their powder rough and angular like bits of glass; as quartz, jasper, flint.

Order V. AGGREGATÆ. Originating from a mixture of the foregoing, and therefore participating their constituent particles; their powder differing accordingly; as granite, puddingstone.

Class II. *MINERÆ*, MINERALS.

Fertile stones, originating from a saline principle by crystallization; compound, as produced from a stony substance (of the preceding class), impregnated by salt, sulphur, or mercury, intimately soluble in an appropriate menstruum, and crystalline.

Order I. SALIA, *Salts*. To be distinguished by the taste, soluble in water; as rock-salt, alum, borax.

Order II. SULPHURA, *Sulphureous Minerals*. Distinguishable by smell, emitting an odour and flaming under the action of fire, soluble in oil; as amber, naphtha, pyrites.

Order III. Metalla, *Metallic Minerals.* Distinguishable by good eyes! very heavy, fusible, soluble in appropriate acid menstrua; as molybdæna, lead, gold, and copper.

Class III. Fossilia, Fossils.

Ambiguous stones, originating from modifications of the substances included in the preceding classes.

Order I. Petrifioata, *Petrifactions.* Impressed with the form of some natural object, as,—

Zoolithus, the petrifaction of an animal of the class Mammalia.

Ornitholithus, a petrified bird.

Amphibiolithus, a petrified frog, snake, &c.

Ichthyolithus, a petrified fish.

Entomolithus, a petrified insect or crab.

Helmintholithus, of the class vermes, including shells.

Phytolithus, vegetable petrifactions.

Graptolithus, resembling figures produced by painting; as florentine and landscape marble.

Order II. Concreta, coagulated from particles agglutinated at random; as urinary and salivary calculi; tartar of wine; pumice, formed by fire; stalactite, formed by air; tophus, produced under water, as oolite.

Order III. Terræ, *Earths.* Pulverized, their particles loose; as ochre, sand, clay, and chalk.

The first edition of the Systema Naturæ, which consisted of fourteen folio pages, was, as has been already related, printed at Leyden in 1735. That which the author reckoned the twelfth, but which was in reality the fifteenth, is the one that ought to be referred to by naturalists, it being the last that was published under his own care and inspection. It appeared at Stockholm in 1766.

An edition, greatly enlarged, was published at Leipsic by Gmelin in 1788, and contains numerous species not included in any of the preceding. "No

nation," says Dr Stoever, "can produce so complete a repertory of natural history as the above. With infinite labour, exertion, and judgment, all the recent discoveries and observations in all the branches of natural science have been united in it" It is, however, as every one who has had occasion to consult it must be aware, a most injudicious compilation, in which a single species is often described under two, three, or even four different names, and in which no improvement corresponding to the advanced state of the science was made in the grouping of the species or genera.

There is an English edition of the same work, translated by William Turton, M. D. London, 1806, 7 vols 8vo.

"We may venture to predict," says Sir J. E. Smith, in his account of the Life of Linnæus, "that as the Systema Naturæ was the first performance of the kind, it will certainly be the last; the science of natural history is now become so vast, that no man can ever take the lead again as an universal naturalist."

SECTION IX.

Decline and Death of Linnæus.

Review of the Medical Writings of Linnæus—His Materia Medica System of Nosology, Theory of Medicine—His last Work, a Continuation of the Mantissa, published in 1771—Declining State of his Health—In 1774, has an Attack of Apoplexy, followed by Prostration of his Intellectual Powers—Another Attack in 1776, from the Effects of which, and Tertian Fever, he never recovers—His Death in 1778—Honours paid to his Memory.

HITHERTO we have considered Linnæus principally as a naturalist; but his merits in another department of science were such as to entitle him to rank among its more eminent cultivators. It will be recollected, that he practised medicine with success at Stockholm; that he was appointed physician to the Admiralty; that on the resignation of Roberg he obtained the professorship of anatomy, which in the following year he exchanged with Rosen, and became, with the consent of the chancellor of the university, professor of botany. As the latter chair, however, was essentially a medical one, he was bound to direct his attention to the sanative powers of plants, as well as to their uses as articles of food, and was moreover obliged to deliver lectures on materia medica and dietetics. He may even be said to have been the founder of the first-mentioned of these branches of medical science. As a text-book for his lectures, he published an ac-

count of the medicinal substances derived from the vegetable kingdom. This treatise, which appeared at Stockholm in 1749, bears the title of Materia Medica, Liber I. de Plantis digestis secundum Genera, Loca, Nomina, Qualitates, Vires, &c. The author seems to have regarded it as one of his most successful performances; for in his private memoirs he remarks of it, that "it is undoubtedly the best work that has appeared in this department of medical science."

In treating of each plant, he first gives its specific character, then a synonyme from Caspar Bauhin, or its discoverer,—thirdly, the country of which it is a native,—fourthly, the Swedish officinal name, the part used, the preparations made of it, and the doses. Its qualities and uses, its effects, the diseases in which it is employed, and the compound medicines of which it forms an ingredient, are then mentioned. At the end of the volume is an index of diseases, with the plants proper for each. Haller's opinion of this work confirms that of Linnæus himself; for, in his Bibliotheca Botanica, he says of it,—"He has referred to their proper genera very many plants which were highly celebrated for their use in medicine, although their true genus was unknown. He also praises various plants, unknown in the shops, for their healing powers. But it is necessary to read the whole work, which is among the best that its author has produced." Two other parts were published afterwards, one on the animal, the other on the mineral kingdom.

The subject of dietetics also engaged his attention in an eminent degree. In this department, however, he did not write any specific volume, but confined

himself to his lectures, which were copious and highly interesting.

In pathology, or rather in nosology, by which latter term is meant the systematic arrangement and precise definition of diseases, his merits are very considerable. His practice was no doubt too limited, and of too short duration, to enable him to form, from his own experience, correct ideas of all the ailments to which man is liable; but it was sufficient to render him capable of methodizing the observations of others; and it requires little penetration to perceive, that one man may learn more in three years than another in fifty. The several classifications of diseases which have been given to the world, possess various degrees of accuracy. Dr Cullen of Edinburgh, whose Synopsis Nosologiæ Methodicæ has been almost universally acknowledged as one of the most successful attempts to reduce to order the complicated phenomena of morbid action, considers the Genera Morborum of Linnæus as the most important work on the subject, next to that of Sauvages. It was first published in 1759 as an academical dissertation, and afterwards as a separate work.

In the system now mentioned he arranges the genera of diseases under eleven classes, as follows:—

I. Exanthematici. Fevers attended with eruptions on the skin.

II. Critici. Critical fevers.

III. Phlogistici. Fevers from local inflammation.

IV. Dolorosi. Painful diseases without fever.

V. Mentales. Diseases in which the functions of the mind are disturbed.

VI. Quietales. Diseases in which the voluntary and involuntary motions and the senses are impaired.

VII. Motorii. Diseases attended with involuntary motion of parts whose action is ordinarily under the influence of the will.

VIII. Suppressorii. Diseases characterized by oppression of the organs, or impeded excretions.

IX. Evacuatorii. Diseases attended with increased excretion.

X. Deformes. Diseases causing deformity of the body, or change of colour in the skin.

XI. Vitia. Cutaneous, external, or palpable diseases.

Systems of nosology are no doubt useful or convenient, in the same manner as systems of zoology and botany; but so complicated are the phenomena of Nature, and so diversified her productions, that no arrangement, made according to any principles hitherto assumed, can possibly discriminate objects in conformity with all their connexions. If this remark required illustration, it might readily be afforded by the mere inspection of any one of the Linnæan classes or orders. Thus, in the class Vitia there are eight orders.

1. *Humoralia.* Diseases attended with vitiated or extravasated fluids; as emphysema, œdema, inflammation, abscess, and gangrene.

2. *Dialytica.* Solutions of continuity; as fracture, dislocation, contusion, wound, laceration, burn, excoriation, chapped skin.

3. *Exulcerationes.* Purulent solutions of continuity; as ulcer, cancer, caries, fistula, whitlow.

4. *Scabies.* Cutaneous diseases; as lepra, itch, pimples, warts, pustule, eschar.

5. *Tumores.* Tumours or swellings; as aneurism, varix, scirrhus, anchylosis, ganglion, exostosis.

6. *Procidentiæ.* Swellings arising from dislocation of soft parts; as rupture, prolapsus, phymosis.

7. *Deformationes.* Distortions; as rigidity of joints, humpback, curved bones, squinting, harelip, plica polonica.

8. *Maculæ.* Spots; as mole, scar, freckle, sunburn.

Now it is obvious that, in a pathological point of view, aneurism, anchylosis, and scirrhus, have no affinity to each other, nor to spina bifida or scrofula, which are all genera of the same order. Nor have the different orders, deformationes, procidentiæ, humoralia, &c. any very perceptible bond of affinity. But the nosological, like the botanical system of Linnæus, without being natural, may be useful; and it were absurd to reject all attempts to classify diseases, because no scheme has been or can be invented, capable of giving each state of the body, or its various parts, its precise position in the mind. However, we have no reason to join the outcry of his biographers against the criticism of M. Vicq d'Azyr, who says, "he should have been the last to write on objects that were foreign to him, because he had recourse to that spirit of detail, and that aphoristic and figurative style, which have been considered as defects even in the works which established his reputation."

"The whole class of envious persons at Upsal," says Dr Stoever, "and in other parts of Sweden, found it strange and inconsistent at first to see the botanist Linnæus appear on the scene as a pathologist. They made very merry at his expense; but the goodness of his cause soon became triumphant." That his nosology was contemptible can hardly be admitted; but that it ever was triumphant, except-

ing in his own university, no one who is desirous of adhering to truth can assert.

His theory of medicine is amusing, if not instructive. He supposes the human body to consist of a *cerebroso-medullary* part, of which the nerves are processes; and a *cortical* part, including the vascular system and its fluids. The nervous system, which is the animated part, derives its *nourishment* from the finer fluids of the vascular system, and its *energy* from an electrical principle inhaled by the lungs. The circulating fluids are capable of being vitiated by *acescent* or *putrid* ferments, the former acting on the serum, and causing *critical fevers;* the latter on the crassamentum, and exciting *phlogistic* diseases. Eruptive ailments are excited by external causes, which he supposes to be animalcula. The cortical or vascular system undergoing continual waste, requires continual reparation, which is effected by means of suitable diet. Its diseases arise from improper food, and are to be remedied by *sapid* medicines; while those of the medullary system are cured by *olid* substances.

Systems of nosology, theories of medicine, and classifications of natural objects and phenomena, agree in this one respect, that they are all eagerly embraced, strenuously defended, fall into disuse, and become subjects of ridicule. Such must be the fate of the Linnæan system of botany, as it has been of the other fancies of its author; and such must be the fate of every system not founded on organic structure and its modifications, or upon external form as connected with internal disposition.

In 1766, he published a small work extending to only twenty-nine pages, entitled Clavis Medicinæ

duplex, Exterior et Interior, which may be considered as a syllabus of his lectures. It contains a view of his theory of medicine, and an arrangement of drugs in thirty orders, according to their sensible qualities.

The last book which he produced was a continuation of his Mantissa, containing new species and genera, with a variety of emendations. Such of his writings as have not been already mentioned, will be noticed in a subsequent section; and in the mean time we resume our narrative, remarking, that few individuals had a longer scientific career than he; forty-four years having elapsed between the appearance of his first tract, the Hortus Uplandicus (in 1731) and the Mantissa (in 1771).

It would appear that Linnæus possessed a good constitution, although we have seen him suffering under attacks of rheumatism, nephritis, and gout. In 1764, as already mentioned, he had a violent attack of pleurisy; after which he passed the period of his convalescence at his villa of Hammarby, where, on the 9th July, he celebrated the 25th anniversary of his marriage. The same year he had the pleasure of marrying his eldest daughter to Lieutenant Bergencrantz.

It does not seem very easy to determine the precise nature of the disease under which he laboured, although it is probable that it was rheumatism and not gout. In the Latin diary of Dr Gieseke, as quoted by Stoever, is the following passage relative to this subject:—"In 1750, I (Linnæus) had such a violent attack of rheumatism (malum ischiadicum), that I had great difficulty in getting home. For a whole week the pain, which was insupport-

able, prevented me from sleeping; for which reason I would have taken opium, but was prevented by a friend who came in on the seventh evening. My wife asked me if I would eat some strawberries. I will try, said I. It was about the beginning of the strawberry-season, and they were in good condition. Half an hour after, I fell asleep, and continued so till two in the morning. When I awoke, I wondered that the pain had abated, and asked whether I had been asleep, which the persons who were watching assured me had been the case. I asked if they had more of the strawberries, and ate up the remainder. I then slept till daylight, when the pain was about my ankles. Next day I ate as many strawberries as I could, and on the second morning was free of pain. I thought that mortification had taken place; but the part was entire, and I was able to get up, although I felt weak. Next year, about the same time, I had an attack, and another the following year, but milder, and it was always alleviated by the strawberries; and from that time I have been free of the disease." This conversation took place in 1771.

In the spring of 1772, he was visited by Dr Murray, professor of medicine and botany at Gottingen, who had been one of his pupils, and had long enjoyed his confidence and esteem. At this period he possessed good health, and was as ardent as ever in his endeavours for the improvement of science. He was appointed rector of the university for the third time, and, during the six months in which he discharged the duties of that office, the conduct of the young men was highly exemplary. When he retired, deputations from all the nations of the students came

to present their warmest thanks, and to beg his permission to print the address which he delivered on resigning.

In 1773, he had another attack of lumbago, and was moreover affected with an epidemic sore throat; but on the whole his health did not suffer materially. This year, a committee of six bishops, six doctors of divinity, and eight literary and scientific individuals, was appointed by the government to undertake a better translation of the Bible into the Swedish language. Linnæus was among the number, having been chosen on account of his knowledge of the animals and plants mentioned in the Scriptures; but it does not appear that he ever engaged seriously in the undertaking, although he made two journeys to Stockholm for the purpose.

While delivering one of his lectures in the botanic garden, in the beginning of May 1774, he had a slight attack of apoplexy, from which he did not recover for some time; and from this period his health rapidly declined. It is said, that the vexation produced by the publication of a letter in which he had confidentially disclosed to a friend the history of his youth, and especially the progress of his courtship, was the exciting cause of this fatal affection. The illustrious Haller, with whom he had corresponded from 1737 to 1766, published a volume of letters, written in Latin by men of literary eminence, and addressed to himself; and, having been always extremely jealous of Linnæus, thought proper to print all his epistles, in order to defend his own character against the accusations of envy which had been but too justly preferred. When he read these communications he was violently agi-

tated, and from that moment his health became perceptibly worse. The apoplectic attack followed soon after; and from a comparison of testimonies on the subject, it seems to us extremely probable that it was occasioned by the causes now assigned.

He did not, however, despair, nor give himself up to inactivity under these distressing circumstances. A Swedish gentleman returning from Surinam, where he had been residing on his estates, brought with him a collection of plants preserved in spirits of wine, which he presented to the king. The latter sent them to Linnæus, whose health was much benefited by the pleasure which the possession of these treasures inspired. He immediately commenced a description of them, which was published in the Amænitates Academicæ,—a work respecting which we shall have occasion to speak in another section.

After this period, however, little remained of his former vigour. His body feeble and emaciated, his mind stripped of its distinguishing faculties, he rapidly sunk into decrepitude. In 1775, he thus describes his state in his diary:—"Linnæus limps, can hardly walk, speaks unintelligibly, and can scarcely write." Even in this condition he received pleasure from occasional visits to his museum, and more especially from the regard of his sovereign, who did him the honour of going from Ekhelsund to Upsal for the purpose of seeing him, and continued in conversation with him a whole afternoon. The following year, finding his infirmities greatly increased, he requested permission to retire from his offices; but the king would not grant it. On the contrary, his majesty doubled his salary, and gave him two

farms, which his children were to inherit. The last words inscribed in his diary are the following:—"Horrebow and Berger, both Danes, and Gruno from Hamburg, came to Upsal as pupils; but Linnæus is so ill that he can with difficulty speak to them; for the tertian fever is added to paralysis, and his weakness is extreme."

In the winter of 1776, he was reduced to the most deplorable condition; and as in the day of his mental vigour he had presented a brilliant example of the human intellect, so now in that of his prostration did he afford an instance of the utter feebleness of our nature. Another attack of apoplexy caused paralysis of his right side, in which he had most frequently suffered pain; his memory failed him to such a degree that he could not remember the names of the most familiar objects; his incoherent and unconnected words indicated a total decay of the powers of his understanding; he could no longer feed, dress, or clean himself; he could not even move from one place to another. The fever continued, and he became extremely emaciated. Yet even in this state he contrived to write a few scarcely-legible letters, one of which was to his friend Baek. It was dated the 9th December 1776, and contained the following sentence:—"God has determined to break all the bonds that attach me to terrestrial objects." Yet to the last he clung to these with a pertinacity as deplorable as it is surprising in a man who had manifested in his writings, if not in his actions, no small degree of piety. For several years previous to his death, his diary contains little else than an enumeration of the incidents most calculated to gratify his vanity;

such as a visit or letter from the king, the adoption of his system in the botanic garden of Paris, the Pope's approval of his works, and similar occurrences.

At the beginning of 1777, he was still at Upsal, and continued in the same lamentable state, although he occasionally enjoyed intervals of intellectual vigour. In general, however, his powers had so much failed, that he ceased to recognise his own works when they were placed before him; and, it is said, even forgot his name. When the season advanced, he was carried to his country-house at Hammarby, where he remained during the summer. In fine weather he was occasionally taken into the garden or museum, that he might see his collections and books, which always gave him pleasure. In autumn his health improved a little, and he returned to Upsal; but, although he had intimated that he was still desirous of rendering himself useful to the university, so far as his decayed faculties might permit, he was unequal to the delivery of his introductory lecture, which was therefore read by his son.

He was still able to go out, however, although the coachman had orders not to take him beyond the limits of the town. In December, he got upon a sledge, and forced his servant to drive him to Safja, about a league distant. The family, finding that he did not return as usual, became extremely uneasy, and sent in search of him. He was found stretched on the covering of his vehicle, and quietly smoking his pipe by the farmer's fire; nor was it without difficulty that he was induced to go home. This is the last remarkable act of his life that has been recorded; and we have nothing more to add, but

that his sufferings daily increased, until, worn out with disease, he expired on the 10th January 1778, in the 71st year of his age. According to the report of his son, in a letter to Mutis, he died of a gouty suppression of urine, terminating in gangrene.

The honours paid to the memory of this great naturalist were correspondent to the high estimation in which he was held. His death was regarded as an irreparable loss to science; and he is said to have "carried to the grave, with the grief of his fellow-citizens, the admiration of the learned of all countries. Upsal was in deep sorrow on the day of his funeral." His body was conveyed to the cathedral, where it was committed to the tomb. Eighteen doctors, who had been of the number of his pupils, supported the pall, and all the professors, officers, and students of the university, followed in procession.

The king, Gustavus III., ordered a medal to be struck in commemoration of him who had contributed so essentially to elevate the Swedish character in the scientific world; and in 1778, at a convention of the Diet, expressed himself in the following terms:—"The University of Upsal has also attracted my attention. I shall always remember with pleasure that the chancellorship of that university was intrusted to me before I ascended the throne. I have instituted in it a new professorship; but, alas! I have lost a man whose renown filled the world, and whom his country will ever be proud to reckon among her children. Long will Upsal remember the celebrity which it acquired by the name of Linnæus." The Academy of Belles Lettres, History, and Antiquities of Stock-

holm, offered a prize for the best panegyric in Latin, French, or Italian. One written in French was received in 1786, but the Academy judging it unsuitable, offered a second prize, which in 1792 was conferred on Mr Gunnar Backmann, a Swede. The late Dr Hope of Edinburgh erected to his memory, in the botanic garden there, a monument bearing the simple inscription, "Linnæo posuit, J. Hope;" and the Duc d'Ayen-Noailles placed in his garden a cenotaph, with the bust of the naturalist in a medallion, surrounded by the *Linnæa* and *Ayenia*,—the latter plant having been dedicated to himself. Three éloges or panegyrics were pronounced; the first by his friend Dean Baek, at a meeting of the Royal Society of Stockholm; the second by M. Condorcet, in the Parisian Academy of Sciences; the third by M. Vicq d'Azyr, in the Medical Society of Paris. In 1787, an association was formed in that city, under the name of La Société Linnéenne, which subsequently changed its designation into that of Société d'Histoire Naturelle. In 1788, the Linnæan Society of London was established by Dr Smith and other admirers of the Swedish sage; and in 1790, another, bearing the same appellation, was constituted at Leipsic. It is unnecessary to mention all the honours that have been paid to this illustrious professor, as his name has been distinguished in all civilized countries beyond that of any cultivator of natural history, and in our own is as familiar as that of Newton or Herschel. We shall therefore conclude with stating, that in 1822 the students of the university of which he had so long been the chief ornament, resolved to erect a statue as a token of their admiration of his charac-

ter. It was executed by a native artist, and in 1829 was erected upon a pedestal of porphyry.

Besides the three medals which were struck in Sweden to perpetuate his memory, his portrait has been repeatedly engraved. It appears, for example, in the edition of the Systema Naturæ, published at Leipsic in 1798; in the second edition of the Species Plantarum, published at Stockholm in 1762; and in the sixth edition of the Genera Plantarum, which appeared in 1748. In Trapp's translation of his life by Stoever is another likeness engraved by Heath, which, being the most characteristic that we could find, has been selected for the purpose of adorning the present volume. In the biography of Linnæus by M. Fée, are two lithographic portraits, one taken at the age of 20, the other at that of 60.

On inspecting our engraving, the physiognomist will readily detect several of the more prominent traits of his character. The person represented is evidently an active, lively little man, possessed of much acuteness, great judgment, love of order, a self-estimation not susceptible of being diminished by opposition, and a love of approbation, prompting his benevolent mind to generous labours.

SECTION X.

Correspondence of Linnæus.

Linnæus's first Letter, addressed to Rudbeck in 1731—His last, to Dr Cusson in 1777—Correspondence with Haller—With Dillenius, Ellis, and other English Naturalists.

THE correspondence of Linnæus was so extensive, that he declared to a friend that ten hands like his were insufficient to return answers to all the letters which were sent to him. Some time before his death, he drew up a list of 150 persons with whom he had maintained a communication of his ideas in writing. Among the earliest of his epistles was one directed to his benefactor, Olaus Rudbeck, professor in the University of Upsal, and is dated the 29th July 1731. The last is addressed to Peter Cusson, M.D. of Montpellier, and was written in 1777.

The first of his correspondents of whom we shall make mention is the celebrated Albert Haller, who was born in October 1708, and died on the 12th December 1777, aged 69. He was eminently distinguished for his knowledge of the physical sciences, as well as by his poetical talents, and his general acquaintance with literature. In fact, he aimed at universal dominion; and the renown of Rousseau, Voltaire, Linnæus, and Buffon, excited his envy of some and his contempt of others of these

celebrated men. After the death of his father, who was an advocate and citizen of Berne, he chose the medical profession; and in 1723, went to Tubingen, where he studied comparative anatomy under Duvernoi. In 1725, he removed to Leyden, then the first medical school in Europe. After taking his degree at the former seminary, he visited England, whence he went to Paris, and dissected under Le Dran. He then proceeded to Basil, to study mathematics under Bernouilli. There he imbibed also a taste for botany,—a science in which he subsequently made great progress. In 1729, he returned to Berne, and commenced his professional career as a lecturer on anatomy. In 1736, he was appointed by George II. to the professorship of surgery and botany in the University of Gottingen. Here he resided seventeen years, in the course of which he distinguished himself by his numerous and important discoveries. But, in 1753, having taken a journey to Berne, where his countrymen received him with the honour due to his talents, he settled there, and, having been elected a magistrate, entered with zeal on the duties of a citizen. The correspondence of Linnæus with this eminent naturalist and physician commenced when the latter was at Gottingen, and originated in a report that he was hostile to the proposed system of the young Swede, who thus supplicates his forbearance:—

"*From Mr Clifford's Museum, April* 3, 1737. . . . . 1. I must declare, that I am anxious to avoid, if possible, all anger or controversy with you; my wish is rather to act in conjunction with you. I should detest being your adversary, and,

as far as possible, I will avoid it. May there be peace in our days!

" 2. I have always, from the time I first heard your name, held you in the highest estimation; nor am I conscious of ever having shown a contrary disposition. Why then should you provoke me to a dispute? Let me know if I have unwillingly offended, and I will omit nothing to satisfy you. I ask but for peace.

" 3. If my harmless sexual system be the only cause of offence, I cannot but protest against so much injustice. I have never spoken of that as a natural method; on the contrary, in my Systema, p. 8, sect. 12, I have said, 'No natural botanical system has yet been constructed, though one or two may be more so than others; nor do I contend that this system is by any means natural. Probably I may, on a future occasion, propose some fragments of such an one, &c. Meanwhile, till that is discovered, artificial systems are indispensable.' And in the preface to my Genera Plantarum, sect. 9,—'I do not deny that a natural method is preferable, not only to my system, but to all that have been invented. . . . . But, in the mean time, artificial classification must serve as a succedaneum.' Therefore, if you establish a natural method, I shall admit it.

" 4. If you detect any mistakes of mine, I rely on your superior knowledge to excuse them; for who has ever avoided errors in the wide-extended field of Nature? Who is furnished with a sufficient stock of observations? I shall be thankful for your friendly corrections. I have done what I could of myself; but a lofty tree does not attain its full stature by the first storm that bursts forth.

" 5. I have been acquainted with most botanists of distinction, who have all given me their encouragement; nor has any one of them thwarted my insatiable desire of natural knowledge. Will you be more severe than any body else? You appear, by your dissertation, too noble to triumph over the ignorance of others.

" 6. You may, with great advantage, and without injury to me, display your profound learning and intimate knowledge of the works of Nature, so as to acquire the thanks of all the learned world. Do but turn over the writings of botanists in general, and you will see, by their earlier performances, how they are puffed up at first with their own consequence, and scarcely able to keep from assaulting others; of which I myself have perhaps been guilty, which I deeply regret, having now learned better. But when these same people have passed a few years in the field of battle, they become so mild, candid, modest, and civil to every body, that not a word of offence escapes them. This chiefly leads me to doubt the truth of the report in question; for I know your reputation has already been long established.

" 7. It seems wonderful to me that I should have excited so much of your displeasure; for I cannot but think there is no work of any author more in unison with my ideas than this essay of yours.

" 8. I, and perhaps I alone, have acquired what I know entirely by the rules you have laid down, of studying without a master. I am still but a learner; and you must pardon me if I am not yet become learned. If knowledge is to be acquired by your mode, the hope of it, at least, still serves to illuminate my path.

" 9. I doubt, indeed, whether you, or any other lecturer, can enter into controversy with propriety. Professors and teachers should, above all things, acquire the confidence and respect of their hearers. If they appear in the light of students, how much of human imperfection must appear, and what a depreciation of their dignity! What man was ever so learned and wise, who, in correcting others, did not now and then show he wanted correction himself? Something always sticks to him. We have lately seen an instance of this in a most distinguished professor, the ornament of his university, who, having long indulged himself in attacks upon schoolmasters, has at last got so severe a castigation from one of this tribe, that it is doubtful whether he can ever recover his ground at all, and certain that he cannot recover it entirely. A very wise physician has declared, that he would rather give up physic, and the practice of it altogether, than enter into public controversy.

" 10. Look over the whole body of controversial writers, and point out one of them who has received any thanks for what he has done in this way. Matthiolus would have been the greatest man of his day if he had not meddled with such matters. Who is gratified by 'the mad Cornarus,' or 'the flayed fox,' (titles bestowed on each other by Fuchsius and Cornarus)? What good have Ray and Rivinus done with their quarrels? Dillenius still laments that he took up arms against Rivinus; nor has the victory he gained added any thing to his fame. Did not Threlkeld give him much more just cause of offence? But he was now grown wiser, and would not take up the gauntlet. Vaillant, at

one time a most excellent observer, attempted to cut his way with authority through the armies of Tournefort; has he not met with his deserts? and would he not have risen much higher had he left him unmolested?

"11. I dread all controversies, as, whether conqueror or conquered, I can never escape disgrace. Who ever fought without some wound, or some injurious consequence? Time is too precious, and can be far better employed by me as well as by you. I am too young to take up arms, which, if once taken, cannot be laid aside till the war is concluded, which may last our lives. And, after all, the serious contentions of our time may, fifty years hence, seem to our successors no better than a puppet-show. I should be less ashamed to receive admonition from you than you must be to take it from me.

"Behold, then, your enemy, submissively seeking your friendship; which, if you grant him, you will be more certain of securing a friend than of stirring up an adversary. I know you to be of a more generous nature than to level your attacks at one who has not offended, unless any enemies of mine have raised doubts in your mind against me. If, after all, I cannot obtain that peace which, by every argument and supplication, I seek of you, I hope you will at least be so generous as to send me whatever you may print on the subject, and I will take care to convey my answers to you.

"If the news I have heard be without foundation, I earnestly beg of you to forgive me for the trouble I now give you."

Linnæus is here exhibited under the influence of

fear, with much flattery and humiliation soliciting the forbearance of a powerful rival; but the report which had reached him was false, and Haller hastened to dispel from the mind of the young botanist the apprehensions under which he laboured. The correspondence thus commenced continued with great regularity, the letters of Linnæus manifesting entire confidence in Haller; who, however, from a feeling of envy, or, as he alleges, in his own defence, thought proper to publish what had obviously been intended to remain private. The publication of these epistles, as we have seen, was productive of great distress to their author; and more especially of the following one, which gives an account of his earlier years. The Swiss professor concludes one of his notes in the following generous terms:—"Farewell, my dear Linnæus! may you enjoy your health and your botanical pursuits, with every advantage for the prosecution of your labours! My studies and engagements, of a different kind, draw me unavoidably aside; but my inclination always leads me to the charms of Flora. To botany I wish to devote my leisure and my old age; and my fortune to the collecting of drawings, plants, and books. May you, from whom Flora expects more than from any other mortal, make the most of your advantages, and one day or other return to a more genial climate! If at any time my native country should invite me, or I can ever, as I hope, return to it, I have fixed upon you, if the situation be worth your having, to inherit my garden and my honours, such as they are. I have spoken on this subject to those in whose hands all these concerns are placed. As soon as I hear from you, I will tell you all the news I can,

for I shall be happy to resume our agreeable correspondence."

The following is Linnæus's answer:—

"Stockholm, Sept. 12th, finished the 15th, 1739.

"Your letter, of which the value to me is beyond estimation, though dated Nov. 14, 1738, did not reach me till the 12th of August of the present year, when I received it from the minister of the German church at this place. Of the cause of its delay I am ignorant.

"A thousand times have I invoked the honoured shade of Hermann! How well did he deserve the compliment of having all the fountains in the royal gardens play on his arrival, if we consider his liberal conduct towards Tournefort! Hermann had previously offered to resign the botanical professorship (at Leyden) in his favour, intending himself to seek some other situation during Tournefort's life. But what shall I say of you, who have conceived so strong an affection for a stranger, as to invite him to accept your professorial appointment, your honours, and your garden! A man could scarcely do this for his brother, or a father for an only son. I can only say, in one word, I have had a numerous acquaintance among my fellow-creatures, and many have been kindly attached to me; but no one has ever made me so bountiful an offer as yourself. I would express my thanks, if possible, but cannot find words for the purpose. Your memory shall be engraved on my heart whilst I live, and shall be cherished by those who come after me.

"I cannot give an answer; but as you have placed yourself in the light of a father, and me of a

son, I will lay before you a sort of history of my life, down to the present time.

"In the year 1730, I taught botany in the garden at Upsal. Our common friend, Dr Rosen, returned thither the same year. I, then a student of medicine, was Professor Rudbeck's deputy in botany, as Rosen was in anatomy; he being likewise the adjunctus or coadjutor in medicine. In 1732, I went to Lapland, and returned; after which, I read lectures on botany and metallurgy for a whole year. I then quitted Upsal, and, as Providence ordained, went into Dalecarlia. Having accomplished my journey, I returned to Fahlun, the principal town of that province. Here I lectured on mineralogy, and followed the practice of physic. I stayed a month at Fahlun, where I was received with universal kindness. A physician named Moræus resided there, who was esteemed rich by the common people. Indeed he was one of the richest persons in that very poor country. With regard to learning, he might undoubtedly claim the first rank among the medical men of Sweden. I have heard him say, a thousand times, that there was no line of life less eligible than the practice of physic. Nevertheless, he was much attached to me. I found myself frequently a welcome visiter under his roof. He had a handsome daughter, besides a younger one, the former of whom was courted, but in vain, by a gentleman of rank and title. I was struck when I first saw her, and felt my heart assailed by new sensations and anxieties. I loved her, and she at length, won by my attentions, listened to my proposals, and returned my passion. I became an accepted lover. I addressed myself to

her father, avowing, not without much confusion, my total want of fortune. He was favourable on some accounts, but had many objections. He approved of me, but not of my circumstances; and desired that things might remain as they were for three years, after which he would tell me his determination. Having arranged my affairs, and made the necessary preparations for a journey, I quitted my native country with thirty-six gold ducats in my pocket. I immediately took my medical degree (at Harderwyk in Holland), but was not in circumstances to return home with much comfort. I remained, as you know, in Holland. In the mean time, my most intimate friend B—— regularly forwarded the letters of my mistress by the post. She continued faithful. In the course of last year, 1738, which I passed at Dr Van Royen's with the approbation of the young lady, though it was the fourth year of my absence, and her father had required but three, B—— thought he had himself made considerable progress in her favour. By my recommendation he was made a professor; and he took upon him to persuade my betrothed that I should never return to my own country. He courted her assiduously, and was very near obtaining her, had it not been for another friend, who laid open his treachery. He has since paid dearly for his conduct, by innumerable misfortunes.

"At last I came back, but still destitute of a maintenance. The young lady was partial to me, and not to him. I settled at Stockholm, the laughing-stock of every body on account of my botany. No one cared how many sleepless nights and toilsome hours I had passed, as all, with one voice, declared

that Siegesbeck had annihilated me. There was nobody who would put even a servant under my care. I was obliged to live as I could, in virtuous poverty. By very slow degrees I began to acquire some practice. But now my adverse fate took a sudden turn, and after so long a succession of cloudy prospects the sun broke out upon me. I emerged from my obscurity, obtained access to the great, and every unfavourable presage vanished. No invalid could now recover without my assistance. I began to get money, and was busy in attendance on the sick, from four in the morning till late in the evening; nor were my nights uninterrupted by the calls of my patients. Aha! said I, Esculapius is the giver of all good things; Flora bestows nothing upon me but Siegesbecks! I took my leave of Flora; condemned my too-numerous observations a thousand times over to eternal oblivion; and swore never to give any answer to Siegesbeck.

"Soon afterwards, I was appointed first physician to the navy. The magistracy immediately conferred upon me the regius professorship, that I might teach botany in the seat of government at Stockholm, with the addition of an annual stipend. Then my fondness for plants revived. I was also enabled to present myself to the bride to whom I had been for five years engaged, and was honourably received as her husband. My father-in-law, rather fond of his money, proved not very liberal to me; but I can do without it, and those who come after me will enjoy it.

"Just now, both the medical professorships are likely to become vacant. Professors Rudbeck and Roberg, both advanced in age, are about offering

their resignation. If this takes place, probably Mr Rosen may succeed Roberg, and I may obtain Rudbeck's appointment. But if I do not, I am content to live and die at Stockholm; nor shall I oppose the pretensions of any competitor. If, therefore, I should not obtain the botanical professorship at Upsal, and you, at the end of three months, should invite me, I would come, if I may bring my little wife with me. Otherwise, if there be any chance of my ever seeing you at Hamburg, for that reason alone I would go thither, though I live here at a great distance. My regard for you makes me wish to know you personally, to see and talk to you, before I die. Farewell! may you long continue to be the load-star of our science!"

Linnæus and Haller, notwithstanding the frequent disputes that took place between them, continued upon the whole on friendly terms, and wrote to each other occasionally, until 1749. The last letter from the Swiss naturalist is dated Berne, April 10, 1766. The correspondence, which is full of interest, more especially with respect to botany, is given by Sir J. E. Smith, from whose "Selection" the above translations have been copied.

"It is to be lamented," says he, "that Haller published so many confidential letters, unjustly reflecting, here and there, on Linnæus; and that he betrays, in his prefaces and notes, so much petulance towards this old and distinguished friend. He pretends, indeed, to have excluded from all the letters he published every thing personal or confidential. But there are few more disgraceful chronicles of ill humour than this collection of letters

of various persons to Haller. He leaves chasms, truly, in many places, which, like Madame Dacier's asterisks, is 'hanging out lights;' for they serve to aggravate the force of what remains. Above all, he is censurable for printing letters from this very son of his, after his death, reflecting severely on persons who had, as the young man says, shown him the greatest favour at Paris; and abusing the Academy of Sciences, which had just elected him into its body as a corresponding member."

Linnæus, in one of his letters to Haller, says, "There is nobody in England who understands or thinks about genera except Dillenius." We may therefore mention, as next in order among his correspondents, this celebrated professor of botany. Born at Darmstadt in 1685, and educated as a physician at Giessen, he was brought to England by Sherard in 1721; and, when the latter, who had been English consul at Smyrna, founded his botanical professorship at Oxford, he appointed him to it.

Dillenius was a plain blunt man, and used great freedom of speech in writing to Linnæus. Thus, in one of his letters, he says,—"I feel as much displeased with your Critica Botanica as I am pleased with your Lapland Flora, especially as you have, without my deserving such a compliment or knowing of your intention, dedicated the book to me. You must have known my dislike to all ceremonies and compliments. I hope that you have burthened but few copies with this dedication,—perhaps only the copy which you have sent me. If there be more, I beg of you to strip them of this vain parade, or I shall take it much amiss. At

least I cannot offer you my thanks for what you have done, though I gratefully acknowledge the favour of the copies you have sent me of the Critica as well as the Flora. We all know the nomenclature of botany to be an Augean stable, which C. Hoffmann, and even Gesner, were not able to cleanse. The task requires much reading, and extensive as well as various erudition; nor is it to be given up to hasty or careless hands. You rush upon it, and overturn every thing. I do not object to Greek words, especially in compound names; but I think the names of the ancients ought not rashly and promiscuously to be transferred to our new genera, or those of the New World. The day may possibly come when the plants of Theophrastus and Dioscorides may be ascertained; and, till this happens, we had better leave their names as we find them. That desirable end might even now be attained, if any one would visit the countries of these old botanists, and make a sufficient stay there; for the inhabitants of those regions are very retentive of names and customs, and know plants at this moment by their ancient appellations, very little altered, as any person who reads Belonius may perceive. I remember your being told, by the late Mr G. Gherard, that the modern Greeks give the name of amanita (ἀμανίτα) to the eatable field-mushroom; and yet, in Critica Botanica, p. 50, you suppose that word to be French. Who will ever believe the *Thya* of Theophrastus to be our arbor vitæ? Why do you give the name of cactus to the tuna? Do you believe the tuna, or melocactus (pardon the word), and the arbor vitæ, were known to Theophrastus? An attentive reader of the de-

scription he gives of his sida, will probably agree with me that it belongs to our nymphæa, and indeed to the white-flowered kind. You, without any reason, give that name to the malvinda; and so in various other instances concerning ancient names; in which I do not, like Burmann, blame you for introducing new names, but for the bad application of old ones. If there were, in these cases, any resemblance between your plants and those of the ancients, you might be excused; but there is not. Why do you, p. 68, derive the word medica from the virtues of the plant, when Pliny, book xviii. chap. 16, declares it to have been brought from Media, &c.?

"I fear I have angered you by saying, as you observe in your last, so much against your system of arrangement. Nevertheless, I could say a great deal more, and should be able to prove to you that you separate and tear asunder several genera nearly related to each other. But this is not my aim, as I value your friendship too much."

In another letter, dated May 16, 1737, he writes as follows:—"I must say a word concerning stamens and styles, as being unfit to found a system of arrangement upon; not only because they vary as much as flowers and seed-vessels, but because they are hardly to be discerned, except by yourself, and such lynx-eyed people;* and in my judgment, every scheme of classification offers violence to nature. Notwithstanding all this, I applaud and congratulate you, in the highest degree, for having

* A singular objection, remarks Sir James E. Smith, from the great sharp-sighted cryptogamist!

brought your premature birth to such perfection. You have accomplished great things, and, that you may go on and prosper still more, let me exhort you to examine more and more species. I do not doubt that you yourself will one day overthrow your own system. You see, my dearest Linnæus, how plainly I speak my sentiments, depending on your candour to receive them favourably."

One of the most respectable of his English correspondents was Peter Collinson, with whom he became acquainted when he visited London in 1736. He belonged to the Society of Friends, possessed a most amiable disposition, evinced the strictest probity and the purest benevolence, was blessed with a genuine and ardent love of nature, enjoyed a long life of active virtue, and died in the glorious hope of a happiness unappreciable. The gentle though rather romantic character of the quaker shines forth in all his letters, but in none more than in the last he wrote, which is as follows:—

"Ridgeway-house, on Mill-hill, ten miles north of London,—March 16, 1767.

"I am here retired to a delightful little villa, to contemplate and admire, with my dear Linnæus, the unalterable laws of vegetation. How ravishing to see the swelling buds disclose the tender leaves! By the public newspapers we were told that with you in Sweden the winter was very severe, the Sound being frozen over. I have no conception of the power of that cold which could fetter the rolling ocean in icy chains. The cold was what we call severe, but not so sharp as in the year 1740. It lasted about a month, to the 21st of January, and

then the thaw began and continued. February the 1st and 2d were soft, warm, sunny days, as in April, and so continued, mild and warm, with southerly winds, all the month. This brought on the spring flowers. Feb. 8th, the *Helleborus niger* made a fine show; the *Galanthus* and winter aconite by the 15th covered the garden with beauty, among some crocuses and violets, and *Primula veris*, &c. How delightful to see the order of nature! Oh, how obedient the vegetable tribes are to their great Lawgiver! He has given this race of flowers a constitution and fibres to resist the cold. They bloom in frost and snow, like the good men of Sweden. These flowers have some time made their exit; and now, March 7th, a tenderer tribe succeeds. Such, my dear friend, is the order of nature. Now the garden is covered with more than twenty different species of crocuses, produced from sowing seeds, and the *Iris Persica, Cyclamen vernale,* and polyanthos. The 16th March, plenty of *Hyacinthus cæruleus* and *albus* in the open borders, with anemones; and now my favourites, the great tribe of narcissuses, show all over the garden and fields. We have two species wild in the woods that now begin to flower. Next, the *Tulipa præcox* is near flowering; and so Flora decks the garden with endless variety, ever charming.

"The progress of our spring, to the middle of March, I persuade myself will be acceptable to my dear baron. Now I come to thank him for his most acceptable letter of the 8th of October last. I am extremely obliged for your kind intentions to send me the work of works, your Systema Naturæ. I hope it will please God to bless my eyes with the

sight of it. I feel the distress you must be under with the fire. I am glad, next to your own and family's safety, that you saved your papers and books. By this time I hope all is settled and in order; so pray now, at your leisure, employ some expert pupil to search into the origin of the nectarine; who are the first authors that mention how and when it was first introduced into the European gardens. It is strange and marvellous, that a peach should naturally produce or bear nectarines, a fruit so different, as well in its exterior coat as flavour, from a peach; and yet this nectarine will produce a nectarine from the stone, and not a peach. This remarkable instance is from a tree of a nectarine raised from a stone in my own garden, which last autumn had several dozen of fruit on it, finely ripened. For more particulars I refer to my last letter. Pray tell me who Perses was, what countryman, and who is the author that relates his introducing peaches into the European gardens?

"That bats as well as flies lie as dead all winter is true; but they do not change elements, and go and live all that time under water. Swallows cannot do it without a provision and contrivance for that end, which it becomes your great abilities to find out; for it is not sufficient to assert, but to demonstrate the internal apparatus God Almighty has wonderfully contrived for a flying animal, bred on the land and in the air, to go voluntarily under water, and live there for so many months. Besides, we are not informed which species lives under water, as there are four species. You, my dear friend, have raised my admiration, and that of all my curious acquaintance; for we never heard before that

mushrooms were of an animal nature, and that their eggs are hatched in water. We must suspend gratifying our curiosity until this phenomenon is more particularly explained to us here. Dr Solander is also a stranger to it. Very probably some account has been published in the Swedish tongue; if that is sent to Solander, then we shall be made acquainted with the discovery.

"I herewith send you a print of the *Andrachne*, which flowered, for the first time I presume in Europe, in Dr Fothergill's garden in May last year. It was raised from seed from Aleppo, sent to him by Dr Russell in the year 1756. You see its manner of flowering is very different from the arbutus. I have a large tree raised from the same seed, that stands abroad in the garden, but never blossomed. It is now beginning to shed its bark, as Belon or Belonius well describes; which is a peculiar difference from the *Arbutus*, and nearly agrees with the *Platanus*.

"I am, my dear friend, with my sincere wishes for your health and preservation, your affectionate friend,

"P. COLLINSON,

"Now entered into my 73d year, in perfect health and strength in body and mind. God Almighty be praised and adored for the multitude of his mercies!—March 16th, 1767."

A great part of the correspondence which Collinson had with Linnæus bore a reference to the alleged hibernation of swallows, which the latter, following the authority of certain writers, supposed to retire on the approach of winter to the bottom of

lakes and rivers, among reeds and other aquatic plants, where they remain in a torpid state till the beginning of summer. This preposterous idea the Englishman labours to convince his friend ought either to be given up, or established by accurate observation; but, if the great botanist was not too proud to renounce an error, he at least manifested no desire to satisfy his correspondent, nor does it appear that he ever afterwards alluded to the subject in any of his letters.

The other individuals with whom he carried on an epistolary intercourse in England were, Dr Solander, his pupil; Mr Ellis, the first who proved the animal nature of corals and corallines; Mr George Edwards, librarian of the Royal College of Physicians, who produced a work on birds; Mr Pennant, the celebrated author of the British Zoology and other treatises; Mr Catesby, who wrote the Natural History of Carolina; Dr Mitchell, and a few more. Of these Mr Ellis appears to have been his most assiduous correspondent.

Mr Ellis to Linnæus.

"London, December 5, 1766.

"Sir,—I am obliged to you for sending me Dr Garden's account of the *Siren*. I am sorry I could not get the rest of the things he sent you, before the ship sailed, when I sent you the specimens of plants. I have only got the insects, which are of little value, and the skin of a *Siren*. The things in spirits are not yet brought on shore; but I hope to get them; and as soon as I have an opportunity, will send them to you. Peter Collinson spent the evening with me, and shewed me a letter you wrote to him

about funguses being alive in the seeds, and swimming about like fish. You mention something of it to me in your last letter. If you have examined the seeds of them yourself, and found them to be little animals, I should believe it. Pray, what time of the year, and what kinds? I suppose they must be taken while growing, and in a vigorous state. I intend to try; I think my glass will discover them, if they have animal life in them. The seeds of the *Equisetum palustre* appear to be alive by their twisting motion, when viewed through the microscope; but that is not animal life.

"I have just finished a collection of the *Corallinæ*. I think there are thirty-six species; but I believe some of them will prove varieties. I have most of the copperplates that represent them finished. They are the most difficult to examine of all the zoophytes; their pores are so small, and their manner of growing so singular.....

"Pray let me know how your Tea-tree grows. It is very odd that, notwithstanding we have had fifteen ships from China this year, we have not had one Tea-tree brought home alive. I have sent a boy to China, whose dependence is on me, to try to bring over several sorts of seeds in wax. I expect him home next summer.

"The English are much obliged to you for your good wishes. We every day see a superiority in the Swedes over the other European nations. All your people that appear among us are polite, well-bred, and learned; without the vanity of the French, the heaviness of the Dutch, or the impudence of the Germans. This last nation has intruded on us swarms of their miserable, half-starved people, from

the connexion that our royal family have had with them."

The first voyage of Captain Cook, in which he was accompanied by Sir Joseph Banks and Dr Solander, interested Linnæus in a high degree, as he expected from it great accessions to science. On being apprized by Ellis of the return of the expedition in 1771, he thus writes in reply:—

"I received, about an hour ago, my ever valued friend, yours of the 16th of July, nor did I ever receive a more welcome letter, as it conveys the agreeable news of my dear Solander's safe return. Thanks and glory to God, who has protected him through the dangers of such a voyage! If I were not bound fast here by sixty-four years of age, and a worn-out body, I would this very day set out for London, to see this great hero of botany. Moses was not permitted to enter Palestine, but only to view it from a distance; so I conceive an idea in my mind of the acquisitions and treasures of those who have visited every part of the globe."

The following letter, principally on the same subject, is selected as one of the best specimens of Linnæus's epistolary style:—

LINNÆUS TO MR ELLIS.

"Upsal, October 22, 1771.

"MY DEAR FRIEND,—I have just read in some foreign newspapers, that our friend Solander intends to revisit those new countries, discovered by Mr Banks and himself, in the *ensuing spring*. This report has affected me so much, as almost entirely to deprive me of sleep. How vain are the hopes of

man! Whilst the whole botanical world, like myself, has been looking for the most transcendent benefits to our science, from the unrivalled exertions of your countrymen, all their matchless and truly astonishing collection, such as has never been seen before, nor may ever be seen again, is to be put aside untouched, to be thrust into some corner, to become perhaps the prey of insects and of destruction.

"I have every day been figuring to myself the occupations of my pupil Solander, now putting his collection in order, having first arranged and numbered his plants in parcels, according to the places where they were gathered, and then written upon each specimen its native country and appropriate number. I then fancied him throwing the whole into classes; putting aside, and naming, such as were already known; ranging others under known genera, with specific differences; and distinguishing by new names and definitions such as formed new genera, with their species. Thus, thought I, the world will be delighted and benefited by all these discoveries; and the foundations of true science will be strengthened, so as to endure through all generations.

"I am under great apprehension, that if this collection should remain untouched till Solander's return, it might share the same lot as Forskal's Arabian specimens at Copenhagen. Thus shall I be only more and more confirmed in my opinion, that the Fates are ever adverse to the greatest undertakings of mankind.

"Solander promised long ago, while detained off the coast of Brazil, in the early part of his voyage, that he would visit me after his return; of which I

have been in expectation. If he had brought some of his specimens with him, I could at once have told him what were new; and we might have turned over books together, and he might have been informed or satisfied upon many subjects, which after my death will not be so easily explained.

"I have no answer from him to the letter I enclosed to you, which I cannot but wonder at. You yourself know how much I have esteemed him, and how strongly I recommended him to you.

"By all that is great and good, I entreat you, who know so well the value of science, to do all that in you lies for the publication of these new acquisitions, that the learned world may not be deprived of them. They will afford a fresh proof, that the English nation promote science more than the French, or any other people whatsoever. At the same time, let me earnestly beg of you to publish, as soon as possible, your own work, explaining those elegant plates of rare zoophytes, &c. which you last sent me. I can no longer restrain my impatience. Allow me to remind you, that 'nothing is so uncertain, nothing so deceitful, as human life; nothing so frail, or surrounded with so many diseases and dangers, as man.'

"Again the plants of Solander and Banks recur to my imagination. When I turn over Feuillée's figures, I meet with more extraordinary things among them than anywhere else. I cannot but presume, therefore, as Peru and Chili are so rich, that in the South Sea Islands as great an abundance of rarities have remained in concealment, from the beginning of the world, to reward the labours of our illustrious voyagers. I see these things now but afar

off. If our travellers should take another trip, I shall have seen them as Moses saw Canaan.

"When I ponder upon the insects they have brought, I am overwhelmed at the reported number of new species. Are there many new genera? Amongst all the insects sent from the Cape, I have met with no new genus; which is remarkable. And yet, except four European ones, they are all new species.

"Pray make use of your interest with Solander, to inform me to what class and order the nutmeg belongs. I shall not take advantage of this information without making honourable mention of my authority.

"When I think of their *Mollusca*, I conceive the new ones must be very numerous. These animals cannot be investigated after death, as they contract in dying. Without doubt, as there were draughtsmen on board, they would not fail to afford ample materials for drawings.

"Do but consider, my friend, if these treasures are kept back, what may happen to them. They may be devoured by vermin of all kinds. The house where they are lodged may be burnt. Those destined to describe them may die. Even you, the promoter of every scientific undertaking in your country, may be taken from us. All sublunary things are uncertain, nor ought any thing to be trusted to treacherous futurity. I therefore once more beg, nay I earnestly beseech you, to urge the publication of these new discoveries. I confess it to be my most ardent wish to see this done before I die. To whom can I urge my anxious wishes but to you, who are so devoted to me and to science?

"Remember me to the immortal Banks and Solander.

"P. S.—I can never sufficiently thank you and Mr Gordon for the beautiful and precious trees of Magnolia, both the Gardeniæ, both the Kalmiæ, and the Rhododendrum; all now in excellent health. But the Calycanthus, and a tree of a new genus allied to Hamamelis, I am sorry to say, are no more. They were very sickly when they came, nor did they put forth any new roots. Dionæa died, as might be expected, in the voyage.

"My Lord Baltimore passed a day with me about a year ago, at my country-house. I read over to him whatever he desired. After his departure, he sent me a most elegant vase of silver gilt, certainly worth more than 150 guineas. I never received so splendid a present before. No Frenchman, nor perhaps any other person, was ever so bountiful. The English are, doubtless, the most generous of all men.

"My second Mantissa is at length published. After it was finished, I received from Surinam what I call Hypericum Lasianthus, so similar to your Gordonia that at first I thought them the same. The flower is, in like manner, internally hairy; the stem is shrubby, and the leaves similar. But the stamens are in five sets, separated by five hairy nectaries. On a careful examination, I conclude your Gordonia Lasianthus to be really a different plant, agreeing with that of Plukenet, in having winged seeds, as you rightly describe it. The synonym of Plukenet, therefore, does not belong to my Lasianthus, which, however like it, is truly a species of Hypericum; but that synonym must be referred to your plant."

Mr Ellis was a native of Ireland, but had settled in London, where he died in 1776. In the early part of his life he engaged in merchandise, and subsequently was employed as agent for West Florida and Dominica. His foreign connexions were the means of furnishing him with rich supplies of curious specimens: and hence both botany and zoology were enriched by him with many discoveries, the most remarkable of which, as we have already mentioned, was that of the animal nature of corals and corallines.

It was to this gentleman that Linnæus recommended his favourite pupil Solander, who came to England in 1759, and who was held in great estimation on account of his politeness and extensive knowledge in natural history. Being engaged by Sir Joseph Banks he accompanied him on his voyage round the world, and on his return was domesticated under his roof as his secretary and librarian. He undertook to describe the objects which had been collected on the voyage; but the dissipation of London society, his other avocations, and the indolence which soon gained upon him, rendered his progress too slow for the expectations of the learned, and in 1782 he was carried off by apoplexy. He seems to have almost forgotten his venerable master, to whom he was under so many obligations, and even his aged mother, several of whose letters to him were found unopened after his death. He was, notwithstanding, a man of considerable merit, and more especially in that he proved the means of establishing the Linnæan doctrines in this country.

Mr Ellis, in return, had the satisfaction of in-

troducing to the correspondence of Linnæus the celebrated Dr Garden, who had settled at Charleston in South Carolina, where he practised medicine for nearly thirty years. He was a native of Scotland, and received his education at Aberdeen and Edinburgh. During the intervals of leisure which occasionally occurred in the practice of his profession, he directed his attention to the study of botany and zoology. When the differences between Great Britain and her American colonies arose, he took part with the former, and returned to Europe about the end of the war, with his wife and two daughters, leaving, however, a son, who submitted to the new government. He died of pulmonary consumption in 1791, in the sixty-second year of his age.

Dr Garden to Linnæus.

"Charleston, Nov. 30, 1758.

"Sir,—Three years ago I troubled you with a letter by way of Holland, of which I sent also a duplicate; but I fear they have both accidentally miscarried. From that period I have often thought of soliciting afresh your friendship and correspondence, but shame has deterred me. I am well aware that your time must be fully occupied with more valuable correspondents, and that I am likely to be more troublesome than useful, having nothing worthy to repay such an indulgence. I do, however, stand in great need of your advice and assistance in the prosecution of the most delightful of studies; and such is my conviction of the benevolence of your character, that I cannot refrain from writing you another letter. I earnestly beseech you to take this

in good part, and not to refuse me the favour of your friendship. Mr Ellis, in a recent letter, encourages me to believe that my correspondence may not be unwelcome to you, which, you may well suppose, has greatly delighted me; and it has induced me to hope you will pardon this intrusion. I learn from him that you have already written to me; and it has given me no small concern that your letter has never come to hand. I flattered myself, as long as I possibly could, with the prospect of its arrival; but I have now given up all hopes, and am only sensible of my loss and mortification.

"Had it not been for the repeated encouragement of Mr Ellis, I should scarcely ever have ventured to expect that my friendship and correspondence could engage your attention; nor can I now attribute your favour and kindness towards me to any other cause than, probably, to the too partial representations of this friend. I fear that his usual indulgence for me, of which I have had repeated instances, may have prompted him to say more in my recommendation than my abilities deserve, or than truth can justify.

"Of this I am very certain, that if you do deign to correspond with me, I can never repay such a favour as it deserves. Nevertheless, I am ready to receive and to obey your wishes and directions; and if this country should afford any thing worthy of your notice, I will, if you please, make descriptions, or send specimens, with all possible care. Your commands will indeed prove most welcome to me. I have only to request that you will inform me of every thing you want, and of the best methods of preserving and forwarding specimens. Every

opportunity that you may be so good as to afford me of serving you, I shall esteem an honour; and if at the same time you favour me with your advice, and allow me to drink at the fountain of pure botanical science from your abundant stores, I shall esteem it the highest honour, as well as gratification, that I can enjoy.

"Almost every one of your works is already in my hands, and I trust I have thence greatly improved my knowledge of botany. Mr Ellis informs me of your being about printing a new edition of your Systema Naturæ and Genera Plantarum, both which I have ordered to be sent me as soon as they appear. From the riches and erudition of what you have already published, your whole mind being devoted to this one pursuit, I am at no loss to anticipate the still greater degree of information, elegance, and perfection, of your future performances. Nothing, indeed, more excites my wishes, as a certain source of pleasure and improvement, than to be more deeply conversant with your writings; that I may not only profit by your genius, but, at the same time, have the information of the most eminent and approved writers in botany always ready at hand.

"I am disgusted with the coarse and malicious style in which some carping and slanderous critics have attacked these works of yours, the delight and ornament of botanical science. But such men are objects of pity rather than anger. Their blind inclination to find fault leads them so far into the mazes of absurdity, that they censure what ought to afford them nothing but instruction. Their futile reasonings, indeed, fall harmless to the ground, like the dart of Priam from the shield of Pyrrhus.

The works they abuse shine brighter the more strictly they are scrutinized, and will certainly be read with delight by men in every age who are best qualified to appreciate their value. Your censors, when duly weighed themselves, seem to have acquired what they know by application rather than by any great powers of mind; and they make but a poor figure, with all that they can find to say, when they enter into a controversy with a man whose learning has received its last polish from genius. Nor are you, my excellent friend, unsupported in the contest; for you are surrounded by all who have entered on the same studies at the impulse of genius, or under the auspices of Minerva, and whose industry has gradually improved, sharpened, and given the last finish to the powers of their understanding. These stand ready armed for the battle in your defence. They will easily put to flight the herd of plodding labourers; for nature can certainly do much more without learning, than learning without nature.

"If your adversaries and detractors had candidly pointed out the disputable, inconvenient, or faulty parts of your system, for your better consideration and revision, I have no doubt that they would now have found in you a friend and patron, instead of an enemy and conqueror. But they were excited by an envious malignity, and a depraved appetite for controversy, to write without judgment or genius, and to blame without candour or liberality. Not that I pretend to say, that your system is already brought to the supreme point of perfection. That would indeed be a foolish assertion, which your better judgment would at once reject as mere

flattery. But to give due praise to supreme merit in botanical science, and to recommend, as they deserve, your most ingenious and most useful writings, is a duty incumbent on me, as well as on all who are not destitute of every spark of gratitude, for the immense services which your labour and ingenuity have rendered to the whole world. Nor are you, sir, so little able to appreciate your own merits, as not to be perfectly conscious that the attacks alluded to originate in envy, rather than the commendations you receive, in flattery. Compliments out of the question, we certainly ought to give every one his due.

"But it is time to conclude. I venture to enclose for your opinion the characters of a very handsome plant, which seems to me a new genus. I am very anxious that it should bear the name of my much-valued friend, Mr Ellis; and if, upon mature examination, you should judge it to be new, I wish you would correct my description wherever it may be necessary, and publish it in the new edition of your Genera Plantarum, under the name of *Ellisia*. This plant grows about the bases of the Apalachian Mountains, rising annually from its old roots to the height of about twelve feet, ornamented with whorls of leaves, at the distance of eighteen inches from each other.

"It only remains for me, sir, to beg your pardon for this intrusion. I am well aware how many important labours you have on your hands, and you probably have many more in prospect. Grant me only your friendly assistance in my ardent prosecution of the study of nature; and may you at the same time go on advancing in reputation and suc-

cess! and after you have given your works to the public, may you long enjoy the honours which your abilities have acquired!

"May God grant you a long life, to investigate the secrets of nature, as well as to improve the powers of your mind in their contemplation! and may your valuable exertions benefit the literary world as long as you live!—Such is my sincere prayer. Farewell!"

In France, the correspondents of Linnæus were Messrs Angerville, Barrere, De Bomare, Duchesne, Carrere, Chardon, Cusson, Guan, Guettard, the two Jussieus, Le Monnier, Maynard, F. de Sauvages, and the Abbé de Sauvages.

ANTOINE DE JUSSIEU, PROFESSOR OF BOTANY AT PARIS, TO LINNÆUS AT HARTECAMP.

"Paris, July 1, 1736.

"SIR,—I received with much pleasure your work on the *Musa*, which I immediately read through with avidity, and no less satisfaction; not only because of the singularity of the plant itself, but for the sake of your remarks. I never suspected that this plant, which I had seen bearing flowers and fruit in Spain, could produce any in Holland, as we have never had an instance of the kind in the royal garden at Paris, where it has not even flowered. None of the other works mentioned as having been published by you have ever reached me, and I shall be greatly obliged by your ordering them to be sent hither at my expense. I long very much to see your Hortus Cliffortianus and Flora Lapponica; especially the latter, as the king has recently sent

some of our academicians towards the most northern parts of Europe, to whom, in their search after plants in those countries, your book would be a guide, instructing them what seeds or dried specimens to send us. If, therefore, you are likely soon to complete this work, I request the favour of two copies, which shall be paid for with the above-mentioned publications. If you know of any thing issuing from our Parisian press likely to be worthy of your notice, nothing will give me more pleasure than to procure it for you. Be pleased, sir, to accept the respects of my brother and myself."

The writer of the above letter was elder brother to the author of the following, who was also Regius Professor of Botany at Paris, and the reputed inventor of what is called the Natural System of Plants, which was subsequently improved by his nephew, Antoine de Jussieu.

BERNARD DE JUSSIEU TO LINNÆUS.

"Paris, Feb. 15, 1742.

"MY DEAREST FRIEND,—I received your welcome letter, and have several times been desirous of answering it, but have as often been hindered by various affairs. Pardon my past neglect, though I have permitted some opportunities of testifying my regard for you to pass by. I have been occupied in various journeys. All last autumn I was wandering on the seacoast of Normandy. I have met with many novelties, among which you will be surprised to find some additions to the animal kingdom. I mean, however, before I make my discoveries public, to examine into the matter more fully.

" I have heard with the most sincere pleasure of your being appointed professor of botany at Upsal. You may now devote yourself entirely to the service of Flora, and lay open more completely the path you have pointed out, so as at length to bring to perfection a natural method of classification, which is what all lovers of botany wish and expect. I know of nothing new here except an essay on the natural history of Cayenne, and a catalogue of officinal plants. These little works will be conveyed to you by the surgeon of Count de Tessin, when he returns home. I shall also add a fasciculus of medical questions, of the faculty of Paris. I have not yet received what you last sent me; but I return you many thanks for your repeated kindness. I beg leave to offer you, as a testimony of my gratitude, a few exotic seeds. May God preserve you long in safety! Believe me your most devoted, BERNARD DE JUSSIEU."

We have nothing of much interest to offer from this quarter, as Buffon, who was the most popular naturalist of his time, showed himself the rival of the Swede and a despiser of all classifications; although, as Lord Monboddo says, " those who have merely made themselves acquainted with the first rudiments of philosophy, cannot possibly be ignorant, that a distribution into genera and species is the foundation of all human knowledge; and that to be acquainted with an individual, as they term it, or one single thing, is neither art nor science."

From the long list of correspondents which Linnæus had in Germany and other parts of the Continent, we shall only mention Professor Gesner at Tubingen; Hebenstreit and Ludwig at Leipsic;

Hermann and Jacquin at Vienna; Gieseke at Hamburg; Murray at Gottingen; Brunnich, Fabricius, and Muller, in Denmark; Gmelin, Ammann, and G. Muller, in Russia; Allemand, Burmann, Gorter, Cliffort, and Van Royen, in Holland; John Gesner and Scheuchzer, in Switzerland. We do not, however, find it necessary to insert any of the letters of these celebrated individuals; but shall conclude with part of a communication to the younger Linnæus, from Don Joseph Celestine Mutis, professor of philosophy, mathematics, and natural history, at the University of Santa Fé de Bogota, in New Grenada.

"From the Mines of Ybagua, Sept. 12, 1778.

"This letter, which I have many a time, in the joy of my heart, had it in contemplation to write to you, my worthy friend, I find myself now scarcely able to begin, on account of the grief with which yours just received has overwhelmed me. As I opened this letter, enclosed in one from a beloved brother of mine who lives at Cadiz, I did not at once discover from whom it came, the superscription being in an unknown hand; but I feared it might bring me an account of the precious life of my valued friend the Chevalier Von Linné being either in danger, or perhaps extinct. When I had read it, I perceived but too certainly the truth of what had been announced in the public papers, that this great man, your illustrious father, was no more. To cultivate his faithful friendship has for many years been my chief ambition, in spite of the wide distance between your polar region and the equator. I wanted resolution to open, soon afterwards, a

packet from M. Gahn, whose handwriting I recognised in the direction, lest I might perhaps find a letter, the last, and now posthumous, pledge of his friendship, flattering me with hopes which I had already abandoned. Allow me, therefore, my dear sir, to recall to your mind those recollections which, however sad, we ought not to forget. If it were possible for you to overcome the feelings of nature, I cannot satisfy the claims of friendship without lamenting, with you, our common loss.

"Let me inform you, therefore, that, so long ago as the year 1761, when I ventured to introduce myself to this great man by a trifling communication, as I had not enjoyed any intercourse with him before my departure from Europe, I was first favoured, in this my distant abode, with one of those letters, so highly valued by the most learned men in Europe. In this, according to his usual custom, your distinguished father endeavoured, in the most attractive style, to stimulate my youthful ardour more and more for the study of nature. From that period I rejoiced to devote myself to his service, and our correspondence was kept up for eighteen years, as regularly as the great distance between us, the negligence of those in whom we confided, and my occasional extensive journeys would admit. By some unavoidable accidents, indeed, many of my letters never reached him; and I have also, too late, discovered that many of his had been lost. Meanwhile, our communications were confidential and exclusive, not extended on my part to any other persons, whether my countrymen or not; for I devoted all my discoveries and all my labours to his immortal genius alone. A little while ago, when I

still supposed him living (as I saw the illustrious name of Von Linné among the members of the Royal Academy of Paris, in a list at the end of the Connoissance des Tems), I was particularly happy to obtain the complete fructification of that most elegant tree which yields the Peruvian balsam, in order that I might satisfy his curiosity, so often expressed, on the subject of the genus of this tree, either by describing it among my new genera, or by transmitting any observations for his use. But when I had just overcome the difficulties which had so long deprived me of this acquisition, and was anticipating the pleasure my excellent friend would receive from the communication, the world was deprived of him. You have lost an affectionate parent, and I a most highly-esteemed patron. I trust that you, my honoured friend, will, with his blood, inherit his exalted genius, his ardent love of science, his kind liberality to his friends, and all the other valuable endowments of his mind. On my part, I shall show my gratitude to his memory by teaching and extolling the name of Linnæus, as the supreme prince of naturalists, even here under the equator, where the sciences are already flourishing, and advancing by the most rapid steps; and where, I am disposed to believe, the muses may, perhaps, in future ages, fix their seat. If my opinion be of any weight as a naturalist, I must declare that I can find no name, in the whole history of this department of knowledge, worthy to be compared with the illustrious Swede. Of this at least I am certain, that the merits of Newton in philosophy and mathematics are equalled in botany, and all the principles of natural history, by the immortal Von

Linné. These great men stand equal and unrivalled, in my judgment, as the most faithful interpreters of Nature's works. I trust, sir, you will not take amiss this testimony of mine in favour of your distinguished parent; for, as you are closely allied to him in blood, I feel myself scarcely less intimately attached, by the particular friendship with which he was so good as to favour me. His memory will ever be cherished by me, as that of a beloved preceptor, and I shall value, as long as I live, every pledge of his regard....."

With this testimony to the transcendent merits of Linnæus we conclude the present section, regarding it as a fit introduction to that which follows, in which we shall attempt to sketch the character of this extraordinary man.

SECTION XI.

Character of Linnæus.

Specific Character of Linnæus—Remarks of Condorcet—Linnæus's Appearance and bodily Conformation—His Habits, mental Characteristics, Sociality, domestic Relations, Parsimony, and Generosity—His Forbearance towards his Opponents, Inaptitude for the Acquisition of Languages, Love of Fame, moral Conduct, religious Feelings—Character of his Writings—Remarks on his Classifications.

THE character of Linnæus, marked as it is by features which the least reflective mind can hardly fail to distinguish as indicative of qualities that seldom present themselves in so high a degree of development, is not difficult to be appreciated.

The method which he employed for characterizing the genera and species of animals and plants, he applied to himself as an individual, and the description which he gave of his own person and mind is too remarkable to be omitted here. It is this:—

"Occipite gibbo, ad suturam lambdoideam transverse depresso, pili in infantia nivei, dein fusci, in senio canescentes. Oculi brunnei, vivaces, acutissimi, visu eximio. Frons in senio rugosa. Verruca obliterata in bucca dextra et alia in nasi dextro latere. Dentes debiles, cariosi ab odontalgia hæreditaria in juventute.

"Animus promptus, mobilis ad iram et lætitiam et mærores, cito placabatur; hilaris in juventute,

nec in senio torpidus, in rebus agendis promptissimus; incessu levis, agilis.

"Curas domesticas committebat uxori, ipse naturæ productis unice intentus; incepta opera ad finem perduxit, nec in itinere respexit."

To convert this aphoristic description into elegant English, such as is employed by writers of the Buffon school,—men of many words and few facts,—would be to destroy its peculiar beauty, which can only be retained in an appropriate translation:—

"The head of Linnæus had a remarkable prominence behind, and was transversely depressed at the lambdoid suture. His hair was white in infancy, afterwards brown, in old age grayish. His eyes were hazel, lively, and penetrating; their power of vision exquisite. His forehead was furrowed in old age. He had an obliterated wart on the right cheek, and another on the corresponding side of the nose. His teeth were unsound, and at an early age decayed from hereditary toothach. His mind was quick, easily excited to anger, joy, or sadness; but its affections soon subsided. In youth he was cheerful, in age not torpid, in business most active. He walked with a light step, and was distinguished for agility. The management of his domestic affairs he committed to his wife, and concerned himself solely with the productions of nature. Whatever he began he brought to an end, and on a journey he never looked back."

"Some time before his death," says Condorcet in his Eloge, "Linnæus traced in Latin, on a sheet of paper, his character, his manners, and his external conformation, imitating in this respect several great men. He accuses himself of impatience, of an ex-

cessive vivacity, and even of a little jealousy. In this sketch he has pushed modesty and truth to their utmost; and they who have known that great naturalist, justly charge him with severity towards himself. There are moments when the most virtuous person sees nothing but his own failings. After describing universal nature in all its details, it may be said that the picture would have remained incomplete had he not painted himself. At the same time it is vexing that he should have painted himself in colours so unfavourable. Judging him by his conduct, no one could have fancied the existence of these defects, nor could they have been known unless he had revealed them." Yet, if the damnatory revelation which he made be, as M. Fée asserts, nothing more than the above sketch, it would appear that he has half in playfulness presented a technical character of himself, such as he would have written of a bear or a baboon. It presents indications of candour and self-reproach, but certainly is, on the whole, much more laudatory than otherwise.

With respect to bodily conformation, he was of a stature rather below the ordinary standard, as has been the case with several very ambitious, active, and successful men. His temperament was the sanguineous, with a proportion of the nervous; whence he was lively, excitable, full of hope, and of great ardour; but since he was in no degree melancholic, some physiologists might puzzle themselves to discover where he obtained his indefatigable industry, his perseverance, his obstinate straightforwardness, and the tenacity with which he held all opinions which he had once received. In youth and middle age he was light, but muscular; whence his

personal agility and energy; but as he advanced in years he became rather full, although with little diminution of his corporeal, and still less of his mental activity. In walking he stooped a little, having contracted that habit from his constant search for plants and other objects. He was moderate in his diet, regulated his mode of living by strict method, and by temperance preserved his energies, that he might devote them to the cultivation of his favourite sciences. His hours of sleep were in summer from ten to five, in winter from nine to six.

Punctual and orderly in all his arrangements, he underwent labours which to most men would have been impracticable. Yet the period of study he always limited by the natural flow of his spirits, and whenever he became fatigued, or felt indisposed for labour, he laid aside his task. Some persons have accounted for the immense extent of his works by simply allowing him industry and perseverance; but they who think so are not aware, that these qualities are generally inseparable from genius of the highest order.

In the evenings he frequently indulged in social intercourse with his friends, when he gave free vent to his lively humour; never for a moment enveloping himself in that reserve with which men of little minds conceal their real want of dignity. Whether delivering a solemn oration at the university, or familiarly conversing with the learned, or dancing in a barn with his pupils, he was respected and esteemed alike.

It is perhaps strange that, although of this joyous temperament, he had not a musical ear, having been in this respect like a man whose character was in almost every point very different, but not less truly estimable,—that great master of moral wisdom, Dr

Johnson. It would even seem that he had a kind of antipathy to certain combinations of harmonious sound, although it is clear that he enjoyed the lively song of the thrush and skylark, which he mentions in his Lapland journey as affording him delight.

With respect to his domestic relations, it is agreed by his biographers that he manifested a very amiable character. He was a faithful and tender husband, although his consort possessed few estimable qualities; a fond and indulgent father, although his children obtained a much smaller share of his solicitude than his garden and museum. His wife, who, as we have seen, took charge of all his domestic arrangements, is described as having been of a masculine appearance, selfish, domineering, and destitute of accomplishments. Unable to hold any share in rational conversation, she had little desire to encourage it in others; and as her parsimony was still greater than her husband's, we may suppose that her mode of management was not very conducive to the comfort of her guests. As a mother being incapable of estimating the advantages of proper training, her daughters were in a great measure left destitute of the polite acquirements becoming their station in society; and the father being, as he says, "naturæ productis unice intentus," did not trouble himself about uninteresting affairs of this nature. The result, so far as regards his son, we shall see in a subsequent section.

It is generally acknowledged that Linnæus was more addicted to the love of gold than becomes a philosopher, and that his style of living was by no means equal to his income. "For my own part," says his pupil Fabricius, "I can easily excuse him

for having been a little too fond of money, when I consider those extremes of poverty which so long and so heavily overwhelmed him. It may also be said in his defence, that the parsimonious habits which he had contracted under the most pressing necessity remained with him ever after, and that he found it impossible to renounce them when he lived in the midst of abundance." This apology may perhaps suffice, especially when we find it asserted that his frugality never degenerated into avarice.

Towards his pupils he conducted himself with the most praiseworthy liberality. To those who were poor he remitted the fees due to him as professor, and even from the rich he on many occasions refused to receive any recompense. Dr Gieseke, when about to leave him in the autumn of 1771, pressed upon him a Swedish bank-note, as a remuneration for the trouble which he had taken in affording him instruction; but he was unwilling to accept it, and it was not till after the repeated entreaties of his pupil that he acceded to his request:—"Tell me candidly," said he, "if you are rich, and can afford it;—can you well spare this money on your return to Germany? If you can, give the note to my wife; but should you be poor, so help me God, I would not take a farthing from you!"—"To the praise of Linnæus," says Mr Ehrhart, "I must farther own, notwithstanding his parsimony, that he neither would nor did accept a single penny as a fee for the lectures which he gave me. You are a Swiss," he once said to me, "and the only Swiss that visits me. I shall take no money of you, but feel a pleasure in telling you all that I know gratis."

His excitable temper not unfrequently betrayed

him into expressions which indicated a great want of self-control; but if he was easily roused to anger, he was as speedily appeased. He was exceedingly pleasant in conversation, humorous, and fond of telling entertaining stories. Constant in his attachments, he was ever disposed to look with indulgence on the faults of his friends; and he was fortunate in the affection which his pupils manifested towards him. But it is said that he was equally tenacious of dislike towards his enemies, or those of whom he had formed an unfavourable opinion.

His opponents he treated with forbearance or contempt, and on no occasion engaged in controversy. In a letter to Haller he says,—"Our great example, Boerhaave, answered nobody whatever: I recollect his saying to me one day, 'You should never reply to any controversial writers; promise me that you will not.' I promised him accordingly, and have benefited very much by it." If he cherished animosity towards his adversaries, it certainly did not prevent him from expressing his esteem for their merits; and as dissimulation had no place in his character, he did not follow the example of those who by private misrepresentations undo the benefits conferred by public encomiums. "I am certain," says Murray, "that had his most unjust and most violent opponents heard him, they could not have refused him their esteem and affection."

No man ever excelled him in the discrimination of natural objects; nor is it necessary for us to enter upon any exposition of the excellencies of his mental constitution, as fitting him for the office which he assumed as legislator of natural history. Active, penetrating, sagacious, more conversant with nature

than with books, yet not unacquainted with the labours of others, he succeeded in eliciting order from the chaotic confusion which he found prevailing in his favourite sciences. His memory, which was uncommonly vigorous, was, like his other faculties, devoted to natural history alone; and it was the first that suffered decay. When he was only fifty years of age it already exhibited symptoms of decline; and a few years before his death it was almost entirely extinguished. In the study of modern languages he had never made sufficient progress to enable him to express his ideas with fluency in any other than his native tongue. His intercourse with strangers was carried on in Latin, of which he had a competent knowledge, although in his letters he paid little attention to elegance, or even in some cases to grammatical accuracy. He used to say to his friends,—"Malo tres alapas a Prisciano, quam unam a Natura,—I would rather have three slaps from Priscian than one from Nature."

The love of fame was his predominant passion. It possessed his soul at an early age, strengthened as he advanced in years, and retained its hold to the last. "Famam extendere factis" was his favourite motto, and that which, when ennobled, he chose for his coat of arms. But his ambition was entirely confined to science, and never influenced his conduct towards the persons with whom he had intercourse, nor manifested itself by the assumption of superiority. Fond of praise, he was liberal in dispensing it to others; and, although nothing afforded him more pleasure than flattery, he was neither apt to boast of his merits, nor disinclined to extol those of his fellow-labourers.

We do not find any remarkable deviations in his general conduct from the straight path of morality. It is true, that in the affair of Rosen the impetuosity of his temper had nearly betrayed him into an act which would have stamped his memory with indelible disgrace; but if he exhibited some of the frailties and errors inseparable from humanity, it is neither our inclination to search them out, nor our province to pronounce judgment upon them. He has been accused of betraying a prurient imagination in the names which he gave to many objects, both in the vegetable and animal kingdoms. It is certain, that a more chastened taste would have enabled him to avoid offence in this matter; but neither in conversation nor in act has any moral delinquency been laid to his charge.

In all his writings there appears a deep feeling of reverence and gratitude towards the Supreme Being; and in the history of his life we find nothing which could lead us to suppose that such feelings were assumed for the occasion. Over the door of his room was inscribed,—"Innocui vivite, Numen adest, —Live in innocence, for God is present." His more important works he commences and ends with some passage from the Scriptures, expressive of the power, the glory, the beneficence of God, the creator and preserver of all things. Whenever, in his lectures or on his excursions, he found an opportunity of expatiating on these subjects, he embraced it with enthusiasm. "On these occasions," says one of his biographers, "his heart glowed with celestial fire, and his mouth poured forth torrents of admirable eloquence." Where is the naturalist, possessed of the true feelings of a man, who does not honour in his

heart the being possessed of such a character! The sneer of the filthy sensualist, who, steeped in pollution, endeavours to persuade his turbid mind that all others are like himself; the scorn of the little puffed-up intellect, which, having traced the outline of some curious mechanism in nature, exults in the fancied independence of its own poor energies; the malice of the grovelling spirit, that, finding itself eclipsed by the splendour of superior talents, strives to obscure them by the aspersions of calumny,—what are they that they should influence our estimation of the character of this great man, who with his ardent piety and the devotion of his faculties to the glory of his Creator, is, amid all his imperfections, an object worthy of our love and esteem. And such he will remain, while the world endures, in the view of every enlightened admirer of the wonderful works of God.

His writings are characterized by extreme brevity, nervousness, and precision. He expresses in a dozen words what might be expanded into half as many sentences. His style certainly is not always pure, nor even on all occasions grammatically correct. He was more desirous to instruct than to entertain, and therefore his expressions are weighed but not ornamented. Yet no teacher ever excited such enthusiasm in his pupils; and since the world began has there been none who gave such an impulse to the progress of natural history. They who can sneer at such a man must be cold and selfish indeed. "The language of Linnæus," says Cuvier, "is ingenious and singular. Its very singularity renders it attractive. His phraseology, and even his titles, are figurative; but his figures are in

general highly expressive. With him, the various means by which Nature ensures the reproduction of plants are their nuptials; the changes in the position of their parts at night are their sleep; the periods of the year at which they flower form the calendar of Flora."

As an example of his manner, when treating of a subject not technically described, we may present his account of the plant to which he gave the name of Andromeda: "This most choice and beautiful virgin gracefully erects her long and shining neck (the peduncle), her face with its rosy lips (the corolla) far excelling the best pigment. She kneels on the ground with her feet bound (the lower part of the stem incumbent), surrounded with water, and fixed to a rock (a projecting clod), exposed to frightful dragons (frogs and newts). She bends her sorrowful face (the flower) towards the earth, stretches up her innocent arms (the branches) toward heaven, worthy of a better place and happier fate, until the welcome Perseus (summer), after conquering the monster, draws her out of the water and renders her a fruitful mother, when she raises her head (the fruit) erect." The analogy that gave rise to this fanciful description, which is contained in the Flora Lapponica, suggested itself to Linnæus on his Lapland journey. "The Chamædaphne of Buxbaum," says he, "was at this time in its highest beauty, decorating the marshy grounds in a most agreeable manner. The flowers are quite blood-red before they expand, but when full grown the corolla is of a flesh-colour. Scarcely any painter's art can so happily imitate the beauty of a fine female complexion; still less could any artificial colour

upon the face itself bear a comparison with this lovely blossom. As I contemplated it, I could not help thinking of Andromeda as described by the poets; and the more I meditated upon their descriptions, the more applicable they seemed to the little plant before me; so that, if these writers had had it in view, they could scarcely have contrived a more apposite fable. Andromeda is represented by them as a virgin of most exquisite and unrivalled charms; but these charms remain in perfection only so long as she retains her virgin purity, which is also applicable to the plant, now preparing to celebrate its nuptials. This plant is always fixed on some little turfy hillock in the midst of the swamps, as Andromeda herself was chained to a rock in the sea, which bathed her feet, as the fresh water does the roots of the plant. Dragons and venomous serpents surrounded her, as toads and other reptiles frequent the abode of her vegetable prototype, and, when they pair in the spring, throw mud and water over its leaves and branches. As the distressed virgin cast down her blushing face through excessive affliction, so does the rosy-coloured flower hang its head, growing paler and paler till it withers away. Hence, as this plant forms a new genus, I have chosen for it the name of *Andromeda*."

"Botany may be compared to one of those plants which flower only once in a century. It first put forth some seed-leaves in the reign of Alexander. After the war of Mithridates, the victorious Romans transported it to Rome, when the root-leaves began to appear. Receiving no further cultivation, it ceased to grow. It was next carried from Italy to Arabia, where it remained until the twelfth century.

It then languished in France during three centuries; its root-leaves began to wither, and the plant was ready to perish. Towards the sixteenth century, however, it yielded a slight flower (Cæsalpinus), so frail that the gentlest breeze might seem sufficient to detach it from its slender stalk. This flower bore no fruit. Towards the seventeenth century, the stem, which had been so long without appearing, shot up to a great height; but its leaves were few, and no flower appeared. In the early spring of this happy period, however, when a gentle warmth had succeeded the frosts of winter, this stem yielded a fresh flower, to which succeeded a fruit (C. Bauhin) that nearly attained maturity. Soon after, this splendid stem was surrounded with numerous leaves and flowers."

These figurative descriptions, however, have no place in the more technical writings of Linnæus, where, on the contrary, all is brief, clear, and precise; but, as we have already presented some specimens of these, it is unnecessary to make any additional remarks.

Notwithstanding the attacks that have been made on his mineralogical system, it is at least deserving of praise, as showing the practicability of arranging the objects belonging to this kingdom of nature according to strict method. In botany his merits were transcendent, and with the mention of that science his name is uniformly associated. He found it in a rude and unsettled state, and left it so admirably disposed, that the beauty and practical utility of his method recommended it to the cultivators of science in all countries. Nor were his labours in the animal kingdom less successful.

The general principles of classification which he introduced, his invention of specific names, his improvements in nomenclature and terminology, and the wonderful precision of his descriptions, rendered the study of these sciences as pleasing and easy as it had previously been irksome and laborious.

All systems flourish and fade. The mineralogy of Linnæus has perished; his zoology, cut down to the root, has sent forth a profusion of luxuriant shoots; and although his botany maintains as yet a strong claim upon the admiration of the lovers of nature, a fairer plant has sprung up beside it, which promises a richer harvest of golden fruits. But should the period ever arrive when all that belonged to him of mere system and technicology shall be obliterated, he will not the less be remembered as a bright luminary in the dark hemisphere of natural science, which served for a time to throw a useful light around, and led observers to surer paths of observation than had previously been known.

SECTION XII.

Catalogue of the Works of Linnæus.

Hortus Uplandicus—Florula Lapponica—Systema Naturæ—Hypothesis Nova de Febrium Intermittentium Causa—Fundamenta Botanica—Bibliotheca Botanica—Musa Cliffortiana—Genera Plantarum—Viridarium Cliffortianum—Caroli Linnæi Corollarium Generum Plantarum—Flora Lapponica—Hortus Cliffortianus—Critica Botanica—Petri Artedi, Sueci Medici, Ichthyologia—Classes Plantarum, seu Systema Plantarum—Oratio de Memorabilibus in Insectis—Orbis Eruditi Judicium de C. Linnæi Scriptis—Oratio de Peregrinationum intra Patriam Necessitate—Oratio de Telluris Habitabilis Incremento—Flora Suecica—Animalia Sueciæ—Oeländska och Gothländska Resa—Fauna Sueciæ Regni—Flora Zeylanica—Wästgötha Resa—Hortus Upsaliensis—Materia Medica Regni Vegetabilis—Materia Medica Regni Animalis—Skänska Resa—Philosophia Botanica—Materia Medica Regni Lapidei—Species Plantarum—Museum Tessinianum—Museum Regis Adolphi Suecorum—Frederici Hasselquist Iter Palestinum—Petri Lœflingii Iter Hispanicum—Oratio Regia—Disquisitio Quæstionis, ab Acad. Imper. Scientiarum Petropolitanæ, in annum 1759 pro Præmio, Propositæ—Genera Morborum—Museum Reginæ Louisæ Ulricæ—Clavis Medica Duplex—Mantissa Plantarum—Mantissa Plantarum altera—Deliciæ Naturæ—Essays printed in the Transactions of the Academies of Upsal and Stockholm.

1. Hortus Uplandicus, sive enumeratio plantarum exoticarum Uplandiæ, quæ in hortis vel agris coluntur, imprimis autem in horto Academico Upsaliensi. Upsal, 1731. 160 pages 8vo. This is the first work published by Linnæus, and in it the plants are already disposed according to the sexual system.

2. Florula Lapponica, quæ continet catalogum plantarum, quas per provincias Lapponicas Westrobothnienses observavit C. Linnæus. It was written in 1732, and inserted in the Acta Litteraria Sueciæ of the same year, but only in part, the second section having appeared in the same collection in 1735.

3. Systema Naturæ, sive Regna Tria Naturæ, systematice proposita, per classes, ordines, genera et species. Lugd. Batav. apud Haak, 1735. 14 pages folio. Of this work we have already spoken at considerable length. The two editions most in use are that of 1766–68, published at Stockholm, being the last that appeared under the author's inspection, and the enlarged but ill-digested one of Gmelin, published in 1788–1792 at Leipsic.

4. Hypothesis Nova de Febrium Intermittentium Causa. Harderovici, 1735. 4to. This is Linnæus's thesis, written when he took his medical degree at Harderwyk in Holland.

5. Fundamenta Botanica, quæ majorum operum prodromi instar, theoriam scientiæ botanicæ per breves aphorismos tradunt. Amst. 1736, apud Schouten. 36 pages 12mo. There have been eight editions of this tract, of which the last was published at Paris in 1774. 8vo.

6. Bibliotheca Botanica, recensens libros plus mille de plantis, huc usque editos secundum systema auctorum naturale, in classes, ordines, genera et species dispositos, &c. Amstelod. 1736, apud Schouten. 136 pages 12mo. There have been two other editions; the last of which appeared at Amsterdam in 1751.

7. Musa Cliffortiana, Florens Hartecampi prope Harlemum. Lugd. Batav. 1736. 40 pages 4to.

8. Genera Plantarum earumque characteres naturales, secundum numerum, figuram, situm et proportionem omnium fructificationis partium. Lugd. Batav. apud Wishof, 1737. 384 pages 8vo. The last edition, corrected by Linnæus, was published at Stockholm in 1764. It contains 1239 genera. Five other editions have appeared since; the two last by Schreber and Hanke.

9. Viridarium Cliffortianum. Amst. 1737. 8vo.

10. Caroli Linnæi Corollarium Generum Plantarum; cui accedit Methodus Sexualis. Lugd. Batav. 1737. 8vo.

11. Flora Lapponica, exhibens plantas per Lapponiam crescentes, secundum systema sexuale, collectas itinere impensis Societ. Reg. Litterar. Scientar. Sueciæ, anno 1732 instituta, additis synonymis, &c. Amstelod. apud Schouten, 1737. An improved edition was published by Sir J. E. Smith, London, 1792.

12. Hortus Cliffortianus. Amst. 1737. One vol. folio.

13. Critica Botanica, in qua nomina plantarum generica, specifica et variantia examini subjiciuntur, selectiora confirmantur, indigna rejiciuntur simulque doctrina circa denominationem plantarum traditur; cui accedit Browalii Discursus de introducenda in scholas Historiæ Naturalis lectione. Lugd. Batav. apud Wishof, 1737. A second edition, with a Dissertation on the Life and Writings of Linnæus, was given by J. E. Gilibert in 1788.

14. Petri Artedi, Sueci Medici, Ichthyologia, sive opera omnia de Piscibus; scilicet Bibliotheca Ichthyologica; Genera Piscium; Synonyma Specierum et Descriptiones; omnia in hoc genera per-

fectiora quam antea ulla. Posthuma vindicavit, recognovit, coaptavit et edidit C. Linnæus. Lugd. Batav. apud Wishof, 1738. A second edition, by Walbaum, appeared at Gryphishaw in 1788–1791. 3 vols 4to.

15. Classes Plantarum, seu Systema Plantarum; omnia a fructificatione desumpta, quorum sexdecim universalia et tredecim particularia, compendiose proposita secundum classes, ordines et nomina generica, cum clave cujusvis methodi et synonymis genericis. Lugd. Batav. apud Wishof, 1738. A second edition came out in 1747.

16. Oratio de Memorabilibus in Insectis, in Swedish. Stockholm, 1739. 8vo. There have been seven editions in Swedish, German, and Latin, one of which was inserted in the Amænitates Academicæ.

17. Orbis Eruditi Judicium de C. Linnæi Scriptis. Upsal, 1741. This pamphlet was published anonymously by Linnæus, to vindicate himself against the attacks of Wallerius. A second edition by Stœver, in his Collectio Epistolarum Caroli a Linné. Hamburg, 1792.

18. Oratio de Peregrinationum intra Patriam Necessitate. Upsal, 1742. 4to. This oration was delivered by Linnæus when he assumed his professorial functions. It is also inserted in the Amænitates Academicæ.

19. Oratio de Telluris Habitabilis Incremento. Upsal, 1743. 4to.

20. Flora Suecica, exhibens plantas, per Regnum Sueciæ crescentes, systematice cum differentiis specierum, synonymis auctorum, nominibus incolarum, solo locorum, usu pharmacopæorum. Lugd. Batav.

apud Wishof, 1745. A second edition was printed at Stockholm, 1755.

21. Animalia Sueciæ. Holm. 1745. 8vo.

22. Oeländska och Gothländska Resa. Travels in Œland and Gothland. Stock. och Upsal, 1745. This work was translated into German by Schreber, 1763.

23. Fauna Sueciæ Regni, Mammalia, Aves, Amphibia, Pisces, Insecta, Vermes; distributa per classes, ordines, genera et species. Holm. apud Salvium, 1746. A second edition also at Stockholm, 1761.

24. Flora Zeylanica, sistens plantas Indicas Zeylonæ Insulæ, quæ olim 1670–1677, lectæ fuere a Paulo Hermanno. Holm. 1747. A second impression was executed at Leipsic, 1748.

25. Wästgötha Resa. Travels in West Gothland. Stockholm, 1747. Translated into German by Schreber, 1765.

26. Hortus Upsaliensis, exhibens plantas exoticas horto Upsaliensis Academiæ a Car. Linnæo illatas ab anno 1742, in annum 1748, additis differentiis, synonymis, habitationibus, hospitiis, rariorumque descriptionibus, in gratiam studiosæ juventutis. Holm. 1748.

27. Materia Medica Regni Vegetabilis. Holm. 1749. 8vo.

28. Materia Medica Regni Animalis. Upsal, 1750.

29. Skänska Resa. Travels in Scania. Stockholm, 1749. 434 pages 8vo. Translated into German by Klein, vol. i. The rest has not appeared.

30. Philosophia Botanica, in qua explicantur fundamenta botanica, cum definitionibus partium,

exemplis terminorum, observationibus rariorum, adjectis figuris. Holm. apud Kiesewetter, 1751. 362 pages 8vo. Seven editions have been published of this splendid work. It has also been translated into English by Rose, and into Spanish by Capdevila.

31. Materia Medica Regni Lapidei. Upsal, 1752. The three parts of the Materia Medica were published separately, and the two last have been inserted in the Amænitates Academicæ. Two editions were afterwards required by the scientific world.

32. Species Plantarum, exhibens plantas rite cognitas, ad genera relatas cum differentiis specificis, nominibus trivialibus, synonymis selectis, locis natalibus, secundum systema sexuale digestas. Holm. apud Salvium. 2 vols 8vo, 1753. Two other editions have since appeared, the last by Trattnet in 1764.

33. Museum Tessinianum, Opera Comitis C. G. Tessin, Regis Regnique Senatoris, collectum. Latin and Swedish. Stockholm, 1753.

34. Museum Regis Adolphi Suecorum, &c., in quo Animalia rariora imprimis Exotica, Quadrupedia, Aves, Amphibia, Pisces, Insecta, Vermes describuntur et determinantur. In Latin and Swedish. Stockholm, 1754. Folio, with 35 plates. The preface has been translated into English by Sir J. E. Smith, and published under the title of Linnæus's Reflections on the Study of Nature.

35. Frederici Hasselquist Iter Palestinum; Ella resa til heliga landet. Holm. 1757. These travels have been translated into German, French, and English.

36. Petri Lœflingii Iter Hispanicum; Ella resa

til Spanksa landerna, uti Europa och America, &c. Holm. 1758. 8vo. This work was translated into English by the Forsters. London, 1771.

37. Oratio Regia, coram rege reginaque habita. 1759. Folio. This is to be found also in the Amænitates Academicæ.

38. Disquisitio Quæstionis, ab Acad. Imper. Scientiarum Petropolitanæ, in annum 1759 pro Præmio, Propositæ: Sexum Plantarum argumentis et experimentis novis, &c. Petropol. 1760. This essay has been inserted in the Trans. of the Petersburg Academy of Sciences, vol. vii. 1761; and in the 22d volume of the Journal Encyclopedique. A translation also published in London in 1786. 8vo.

39. Genera Morborum, Upsal, 1763. Three editions.

40. Museum Reginæ Louisæ Ulricæ, in quo Animalia rariora Exotica, imprimis Insecta et Conchylia describuntur et determinantur; et Musei Regis Adolphi prodromus tomi secundi. Holm. 1764.

41. Clavis Medica Duplex, exterior et interior. Holm. 1763.

42. Mantissa Plantarum, generum editionis sextæ et specierum editionis secundæ. Holm. 1767.

43. Mantissa Plantarum altera. Holm. 1771.

44. Deliciæ Naturæ, an oration delivered in 1772. It was translated into Swedish by Linnæus himself, at the request of the students, and published at Stockholm, 1773. 8vo. The Latin edition has also been printed in the Amænitates Academicæ.

Besides the above works, of which the Systema Naturæ alone would have sufficed to immortalize its author, he published numerous essays on various

subjects in the Transactions of the Academies of Sciences of Upsal and Stockholm.

In the Transactions of the Upsal Academy:—

1. Animalia Regni Sueciæ, 1738.
2. Orchides, iisque affines, 1740.
3. Decem Plantarum genera nova, 1741.
4. Euporista in Febribus intermittentibus, 1742.
5. Pini usus œconomicus, 1743.
6. Abietis usus œconomicus, 1744.
7. Sexus Plantarum, 1744.
8. Scabiosæ novæ speciei descriptio, 1744.
9. Penthorum, 1744.
10. Euporista in Dysenteria, 1745.
11. Sexus Plantarum usus œconomicus, 1746.
12. Theæ potus, 1746.
13. Cyprini speciei descriptio, 1746.

In the Transactions of the Stockholm Royal Academy of Sciences:—

Vol. I. 1739–40.

1. Cultura plantarum naturalis.
2. Gluten Lapponum e Perca.
3. Œstrus rangiferinus.
4. Picus pedibus tridactylis.
5. Mures Alpini Lemures.
6. Passer nivalis.
7. Piscis aureus Chinensium.
8. Fundamenta œconomiæ.

Vol. II. 1741.

9. Formicarum sexus.

10. Officinales Sueciæ Plantæ.
11. Centuria Plantarum in Suecia rariorum.

Vol. III. 1742.

12. Plantæ Tinctoriæ Indigenæ.
13. Amaryllis formosissima.
14. Gramen Sœlting.
15. Fœnum Suecicum.
16. Phaseoli Chinensis species.
17. Epilepsiæ vernensis causa.

Vol. IV. 1743.

18. De Uva Ursi seu Jackas Hapuck Sinus Hudsonici.

Vol. V. 1744.

19. Fagopyrum Sibiricum.
20. Petiveria.

Vol. VI. 1745

21. Passer procellarius.

Vol. VII. 1746.

22. Limnia.
23. Claytonia Sibirica.
24. De vermibus lucentibus ex China.

Vol. X. 1749.

25. Coluber (Chersea) scutis abdominalibus 150, squamis subcaudalibus 34.
26. Avis Sommar Guling appellata.
27. Musca Frit, insectum quod grana interius exedit.
28. Emberiza Ciris.

Vol. XIII. 1752.

29. De Characteribus Anguium.

Vol. XIV. 1753.

30. Novæ duæ Tabaci species, paniculata et glutinosa.

Vol. XV. 1754.

31. De plantis quæ Alpium Suecicarum indigenæ fieri possint.

32. Simiæ, ex Cercopithecorum genere, descriptio.

Vol. XVI. 1755.

33. Mirabilis longifloræ descriptio.

34. Lepidii descriptio..

35. Ayeniæ descriptio.

36. Gauræ descriptio.

37. Lœflingia et Minuartia.

Vol. XX. 1759.

38. Entomolithus paradoxus descriptus.

39. Gemma, penna-pavonis dicta.

40. Coccus Uvæ Ursi.

Vol. XXIII. 1763.

41. De Rubo arctico plantando.

Vol. XXIV. 1764.

42. Observationes ad cerevisiam pertinentes.

Vol. XXIX. 1769.

43. Animalis Brasiliensis descriptio.

44. Viverræ naricæ descriptio.

45. Simia Œdipus.
46. Gordius Medinensis.

Vol. XXXI. 1770.

47. Calceolariæ pinnatæ descriptio.

Many of the doctrines discussed in the course of his lectures were converted by his pupils into subjects of academical dissertations. These were published by him, under the name of Amœnitates Academicæ,—a collection which comprises many admirable essays in natural history, medicine, domestic and rural economy. The first volume appeared in 1749, the seventh and last in 1769. An edition in ten volumes, containing also the later essays of Linnæus himself, was published by Schreber in 1785–91. Selections from the Amœnitates have also been printed in English and German.

It has been judged necessary to give at least the titles of the numerous works of Linnæus, because the list may be useful to those desirous of examining them generally, or of referring to a particular treatise. The influence which they exercised upon the advancement of science, and especially upon that of botany and zoology, we shall have occasion to notice in the second volume of the present work.

SECTION XIII.

A brief Notice of Linnæus's Son.

Unnatural Conduct of the Mother of the Younger Linnæus—His Birth and Education—In his eighteenth Year he is appointed Demonstrator of Botany, and, three Years after, Conjunct Professor of Natural History—He visits England, France, Holland, Germany, and Denmark—On returning engages in the Discharge of his Duties; but at Stockholm is seized with Fever, which ends in Apoplexy, by which he is carried off—His Character and Funeral.

ALTHOUGH the younger Linnæus has been considered as a botanist rather than a zoologist, a brief notice of him may be suitably appended to the biography of his father, more especially as he can scarcely be said to have possessed an independent existence, either as a man or as a naturalist. The victim of domestic tyranny, he seems to have lost whatever energy he might originally have possessed, and to have passed through life without being influenced by those powerful motives which usually impel ambitious men in their career. His mother, who in her conduct towards him bore some resemblance to the infamous mother of Savage the poet, entirely broke his spirit, which perhaps was never of the most ardent or aspiring description. Not content with making his home as uncomfortable as she could, she conceived a positive hatred for her only son, which she displayed by

every affront and persecution that her situation gave her the means of inflicting on his susceptible and naturally amiable mind.*

Charles Linnæus was born on the 20th January 1741, at the house of his maternal grandfather, Morœus, at Fahlun. From his earliest childhood he was encouraged by his father in the attachment which he manifested to natural objects, especially plants; and when only ten years old, he knew by name most of those which were cultivated in the botanic garden at Upsal. A stranger, however, to the "stimulus of necessity," which had urged his parent to surmount every obstacle, he appears not to have exhibited any indications of enterprise or enthusiasm. Notwithstanding this, in his eighteenth year, he was appointed demonstrator in the botanical garden, and at the age of twenty-one commenced authorship by publishing a decade of rare plants. Within twelve months another decade was produced, but the work was discontinued, for what reason is not known. In 1763, he was nominated conjunct professor of botany, with the promise that after his father's death he should succeed him in all his academical functions. In 1765, he took his degree of doctor of medicine, and began to give lectures; but, owing to the causes already alluded to, his fondness for science soon degenerated into disgust.

When he was thirty-seven years of age his father died, and he succeeded to his offices; but his mother forced him to pay for the library, manuscripts, herbarium, and other articles, which he

* Life by Sir J. E. Smith.

ought to have inherited. However, a stimulus was thereby imparted which roused him from his lethargy, and he began in earnest to discharge the duties that were imposed upon him, among which were the arrangement of his father's papers, and the superintendence of new editions of several of his works. A third mantissa or supplement to the Systema Vegetabilium, left in manuscript by Linnæus, and enlarged by his son, was published at Brunswick in 1781, under the care of Ehrhart.

The young lecturer had long been desirous of travelling, but during his father's life had found it impossible to gratify his inclination. Being now his own master, he prepared to visit the principal countries of Europe; and, as Thunberg had been appointed demonstrator of botany, the government granted him permission. Want of money, however, presented an obstacle; to overcome which he found it necessary to borrow a sum of his friend Baron Alstrœmer, to whom he resigned his juvenile herbarium in pledge. At London, where he arrived in May 1781, he was received with enthusiasm, and treated with every possible attention by his father's friends and correspondents, especially Sir Joseph Banks, in whose house he principally resided. Here he occupied himself in preparing several works, such as a System of the Mammalia, and a Treatise on the Liliaceæ and Palms; but an attack of jaundice interrupted his pursuits, and his happiness was further diminished by the death of his friend Solander.

On recovering from his illness, he proceeded to Paris in the end of August, accompanied by M. Broussonet. In that capital he was loaded with all

the attentions which were due to the son of Linnæus, and passed the winter among a circle of learned and ingenious persons. In the spring of 1782, he visited Holland, where he inspected the gardens and museums, and received, as in England and France, the most valuable contributions to his collections. He next proceeded to Hamburg, from whence he went to Kiel to visit his friend Fabricius, the great entomologist. At Copenhagen he experienced the same respectful kindness as in the other great cities. In January 1783, he went to Gottenburg, to render his homage of gratitude to Baron Alstrœmer, and in February returned to Upsal.

By this journey he had increased his knowledge, established useful connexions, collected many valuable specimens, and emancipated himself from the state of listlessness into which he had previously fallen. Hopes were entertained that he might prove a worthy successor to the legislator of natural history; and there is no reason to doubt that he would at least have acquitted himself honourably in the discharge of his duties.

But in the month of August he had occasion to go to Stockholm, where he was seized with a bilious fever, which, however, soon abated, so that he was able to return home. There he experienced a relapse; and having imprudently exposed himself to the cold and damp of the apartment in which his collections were kept, a third accession of fever came on, accompanied with apoplexy, which carried him off on the 1st of November 1783, in the forty-second year of his age.

He is said to have possessed a vigorous frame of

body, and even to have inherited his father's looks, but without his energy, his activity, his consciousness of talent, or his love of adulation. He was, on the contrary, gentle and retired. Had he really been endowed with genius similar to that of his parent, he must have distinguished his career, brief as it was, by some meritorious performance. But it is no doubt wisely ordered that superiority of intellect should not, like the distinctions conferred by birth and fortune, be hereditary.

His remains were solemnly deposited, on the 30th of November, in the cathedral at Upsal, close to those of his father. A funeral oration was pronounced by M. Von Schulzenheim; and as the male line of the family had become extinct, his coat of arms was broken in pieces. The gardener of the university then strewed flowers over the grave "of a generation that," to use the words of one of its historians, "will remain great and imperishable as long as the earth, and Nature, and her science shall exist!"

After the death of this young man, the collections, library, and even the manuscripts, of his father, were offered for sale, and purchased by Sir James Edward Smith, the founder of the Linnæan Society of London. They are now in the possession of that illustrious body, whose labours have tended so much to forward the progress of natural history in general, and of botany in particular. The herbarium, which is contained in two deal presses, similar to the model described in the Philosophia Botanica, is to the botanist an object of great interest, and has been the means of elucidating many doubtful points. The building in which

his museum was kept at Hammarby, although it now contains only the chair in which he sat when delivering his lectures, and a stuffed crocodile suspended from the roof, continues to attract the notice of strangers, who generally carry away with them a specimen of the *Linnæa*, which grows profusely in the neighbourhood.

It may be mentioned, in conclusion, that the widow of the great Swedish naturalist survived him fourteen years, having died in 1806, after attaining the 94th year of her age.

THE END.

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